SCIENCE

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THE ORIGINS OF ENGINEERING[1]

By Professor DUGALD C. JACKSON

THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

IT is a romance—the story which relates the gradual unfolding of scientific discovery and invention and their influence on the rise of social organization. It is a romance, and yet it is real. The romance embraces the transfer of physical labor from human shoulders onto machines and the increase of emphasis on human intelligence in contrast with brutality; which is the tale of the origins and growth of engineering.

The story wanders from quarter of the globe to quarter of the globe—from Mesopotamia and Egypt to China, Persia, Arabia, Phoenicia, Greece, Rome, Britain, the European continent, Africa, North America, South America—from race to race, from peoples to peoples, from the latter part of the Paleolithic age of man to the present time. In early ages even slight contacts by means of pilgrims and adventurous traders resulted in the retailing and circulation of romantic stories of conveniences in the possession of distant alien peoples. Thus one area crudely copied and then perhaps improved upon the deeds of other areas. Where two distantly alien peoples grew in organization simultaneously but without contact, the urge for convenience sometimes resulted in simultaneous inventions of equivalent natures. Ambition and craving for convenience seem to sow the atmosphere with ideas which simultaneously may be reached after in different quarters of the world.

Instinct alone was sufficient to inspire the prehistoric man to choose a cave for his abode in temperate zones or to arrange a grass-and-leaf shelter in tropical areas. Those things are done by the dumb beasts through the exercise of instinct. Perhaps to instinct may be ascribed the first use of fire by prehistoric man. It possibly did not require creative intellect for the cave man to build a fire in the cave and to roast

[1] Address as vice-president and chairman of Section M, American Association for the Advancement of Science, Boston, December 30, 1933.

meat, after the heat of a lightning-set forest fire had exhibited itself to him and the flavor of fawn accidentally roasted in that fire had been tasted. However, further changes in the modes of living came to pass with the development of simple man-made structures and machines that required creative spirit. Here was the birth of engineering in its earliest simple embodiments. This birth was an outcome of the lives of a creative-minded few living in the prehistoric days. The period apparently was tens of thousands of years ago, and records of those days are lacking; but we can hypothetically reproduce the conditions with considerable convincingness, utilizing for background a combination of archeological data and human psychology.

Tropical plains watered by great or small rivers are and have been subject to overflows that culminate in great floods in recurrent rainy seasons. It may be surmised that tropical dwellers in grass-and-fern-leaf shelters found their shelters periodically swept away in the waters, while they, themselves, fled for safety to higher ground in company with the jungle beasts. However, some dweller, more active-minded and physically indolent than his fellows, became discontented at the inconvenience of periodically restoring his shelter and slaving to replace whatever other movables he had possessed. The sharpness of this discontent finally caused him to use his mind and observe that the flood had never submerged a near-by rise in ground. Here was the first hydrographic survey. He built his new shelter on the rise.

After further floods, his slower-witted fellows followed the example and a community or village of shelters grew up. Thus early, loose community relations were formed. Such communities of grass houses can still be observed on high ground of the plains of Indo-China and Siam, of course with many ameliorations of conditions compared with the earliest communities. It is likely that the village-community tendency chronologically succeeded the individual engineering observation and the resulting improvement. This chronological relation is important to note.

The cave-men's problem was different. We may picture it as a problem of fire instead of water. Smoke from the fire built in a cave dwelling disturbed the proprietor's relaxation and sleep. Expostulations, however strong, with the fire-tenders (the women and children) were fruitless. Finally one male cave-dweller, more active-minded than his fellows, was so annoyed at his own continued inconvenience that he undertook to modify the situation. This resulted, through cut and try, in a fireplace structure at the mouth of the cave made of flat stones and partly protecting the fire from wind and weather.

The slower-witted cave-dwellers gradually came to more or less copy the first successful structure, and thus some of these dwellers secured relief from inconvenience as a consequence of the invention of their fellow man. The stone huts of the aboriginal Kabiles, who now dwell in the mountains of Algeria, which huts are windowless and have ingress and egress through a hole in the roof that also serves as a smoke outlet, may be a development that grew out of the idea of this first crude fireplace structure. If this inference is correct, it is another illustration of the chronological relation of the village community tendency to engineering observation and improvement.

Tools and also simple weapons are evidences of artisanship. We must seek for the trail of structures and machines, as distinguished from artisanship, in order that we may trace the development of engineering through its origins. I have referred to possible examples of rudimentary steps in the development of structures. The development of machines apparently lagged. The effort required for combining mechanical elements into machines demands a deeper intellectual exertion than was required to make rudimentary surveys and plan rudimentary structures. The archeologists' deciphered records of machines only go back for periods of some thousands of years. The advantage of differentiating between implements of like kind according to their intended use, by making variants for different kinds of use, seems to have been recognized very early. An example is a variant of arrows provided with stone heads in the stone age, which it is inferred from what data exist were so arranged that war arrows left the head in the wound when the shaft was withdrawn and hunting arrows could be withdrawn intact from the stricken animal. The creative quality required for invention of machines, however, is too abstruse to become stirred until the friction of inconveniences in living has created much mental warmth.

The wheel, an extraordinary contribution to muscular relief which we now take for granted as though it were a part of original genesis, is a work of man that comes as a tool to us moderns from the musty ages of unrecorded history. If, as ethnologists tell us, human intelligence has not changed in qualitative character over long ages measured in ten-thousands of years, we can reliably picture the mode of development of the wheel and its application to vehicles. One conceivable path for the invention is easily traced in the light of our present modes of mental reaction. Nomadic habits began very early, either for families, clans or tribes, and we can picture the discontent of the most mentally active men, even in a crude and unformed race, as they season by season faced the inconveniences and wear and tear of family movings across country. The physically indolent but mentally

keenest of the men became wearied of dragging individual belongings or having them half carried by draft animals, or of transporting them on the backs of women and children or of loading the personal riding horses with goods. The delays pertaining to such transport naturally added to the annoyance. The weariness from time to time must have sunk to the soul of some such man, desire for release from the deadly annoyance must have fired his mind, and inventions followed as time progressed. Sleds are known to have been utilized in the early ages. Loose rollers were also utilized. Then controlled rollers may have been tried and other such expedients. Finally, two sections sawed off the end of a roller, mounted at the ends of a wooden trunk, gave the wheels-and-axle structure, and the two-wheeled cart was on the way. Dr. George Grant MacCurdy says the wheel is a Neolithic invention. Its introduction into use was slow until recent millennia, because hunting and fishing probably were the principal sources of food for men in the Neolithic age, formal agriculture and domestication of animals not then being generally practised, and tribal nomadism not yet established.

In a developed brain like that of early Neolithic man, the ability for invention may have existed, but sufficiently sharp recognition of keen inconvenience may not yet have chanced to arise in such a manner as to cause its exercise on complex improvements. Beginning with the latter part of the Stone Age when the numbers of people were considerable in various parts of the world and hand weapons had become effective, the insecurity of life and property was appalling, according to our standards. However, with each step forward in progress by inventions, the tendency toward community living accompanied by a growing respect for mutual interests seems to have become greater. It was only after the stimulus for making inventions had resulted in an easier life with respect to food and shelter and had released more time for cultivating physical ease that growing ethical relations between man and man and tribe and tribe became evident and community living became smoother. The speculative philosophers sing an intellectually interesting story which describes the fabric of civilization, but it is the inductive scientists and inventors on whom the unfolding of the fabric has depended and continues to depend. It is from the work of the latter that the origins of engineering have been derived, and additional origins will become disclosed as long as their work continues.

It seems rather well established that man enslaved fire and converted it to his service in the Pleistocene Age of geology, some hundreds of thousands of years ago. It also seems well indicated that *Homo sapiens* did not rise up and start upon his career of great inventions until some tens of thousands of years ago. *Homo sapiens* apparently began his special career by the domestication of animals and crudely establishing the cultivation of agricultural crops. Man already was distinguished as the user of crude tools and weapons made of stone and bone. As far as speaking for its conditions of life is concerned, the far past is as silent as a basket of clams, but it has left its records nevertheless.

The development of agriculture came in the Neolithic Age, possibly some 10,000 years before the Christian era. It may have been keenly practised first in Egypt some 6,000 to 10,000 years ago, but perhaps was actively practised earlier in Mesopotamia or some other favorable region of the world. Agriculture led to the production of machines to aid in the cultivation and in the preparation of its products.

A simple beginning of such machines might be machines for winnowing and grinding grain—very rude ones at first, but gradually taking improved and more complex forms. It may be presumed that winnowing was originally carried on by the manual process of tossing the grain and chaff of the threshing floor into the air and allowing the natural breeze to make the separation. This process still may be seen in many parts of the world, as for example in Algeria, where it may be observed in practise alongside of the operation of modern combine harvesters. The winnowing van is known to have been used in China in very early times, and perhaps also in Japan where it still may be seen in elementary forms used in the rice fields along with hand fans.

Crude plows drawn by bullocks are known to have been in use some two thousand years earlier than the period when (as Byron puts it) "The Assyrian came down like a wolf on the fold" at Jerusalem some 700 years before the Christian era.

The shadoof or hand-operated well-sweep was used in Egypt more than 3,500 years ago. Ropes and pulleys were used for raising waters from wells before the date of historical records. Perhaps animals such as bullocks were applied as motive power where agricultural irrigation was the purpose, much in the manner still widely used in India. Apparently the treadwheel applied to raising water for use on the land (which is still to be seen in China) also was used in prehistoric times. The treadwheel seems to have been followed by the noria in which the flowing stream impinging on peripheral paddles caused the rotation of the wheel instead of using man or beast on the treadwheel. The so-called Persian wheel, also of great antiquity, is apparently an improved offshoot of the noria. The picotah, on which a man or beast traveled on the tilting lever, made an advance on the shadoof where continuous operation was a need. The

chain of buckets for raising water from a well also apparently comes down from primitive man, and likewise the simple chain pump.

Raising water for irrigation purposes from wells was a highly important act in many regions occupied by man even in prehistoric time and also in the early periods of history, as it is now in some regions, such as our own southern California and in India. How far into antiquity the atmospheric or suction-pump goes is obscure, but apparently the qualities of the siphon were known as far back as 1,500 years before Christ. Out of the water situation may have grown other devices. For example, syringes perhaps grew out of efforts to adapt bellows (possibly of a plunger type) to use with water. The plunger churn, the origin of which goes very far back, may have similar roots.

It is to be borne in mind that in the earlier days of the Paleolithic period esthetics, art and creative endeavor had not stirred appreciably in the intellect of man. The efforts for securing shelter and bare subsistence were sufficiently exacting to occupy fully the intellectual possibilities of mankind. Whatever effort of invention was forthcoming was to abate nuisance, reduce required muscular effort or conduce to safety.

The profound influence which a developing agriculture had on the life of prehistoric man probably is indicated by the usage of many existing primitive races, who name the natural seasons of the year in accordance with their relations to the normal weather and to planting and harvesting times. With the change from primary reliance for food on hunting and fishing, through a food supplement from agriculture, to primary reliance on agriculture for food, the influence of the agricultural life became gradually entrenched, even though the agricultural population itself might be seasonally nomadic. A suitable territory is capable of supporting a larger population of followers of agriculture than of hunters and fishers. Mutuality becomes more useful and the family unit becomes more integrated and ultimately the clan, the tribe, the community and the nation are successively recognized as units in the course of increasing population density. The opportunities for and the utility of inventions become larger with the increasing density of population. Thus engineering derives a steadily increasing influence.

Civilization means an advanced state of material and social well-being, and its foundations were laid with the domestication of animals and the practise of agriculture. Therefore we engineers as well as other citizens are in debt to agriculture. Let us see what engineers have done in this country and these modern times to discharge our ancient debt to agriculture.

The present generation plays its parts with three major branches of applied science—agriculture, medicine and engineering. As we know them in their present states they are all founded on modern scientific discoveries but with the roots of their establishment reaching back to primitive man. Agriculture has not come forward commensuratively with preventive medicine and the engineering industries. But with the automobile, the tractor, manufactured nitrates, diversified cropping, hard-surfaced roads, electrical power in the rural communities all established as they bid fair generally to be, agriculture may rival its brothers in wonders, provided wisdom prevails in guiding the movement. Already many as yet uncorrected faults have been disclosed in the train of a general change from subsistence farming to commodity farming, and wisdom seems lacking for the correction of these faults as well as for fending against causes of additional faults.

The engineers have a responsibility in this. The problem of diversified cropping, I take it, is the farmers' own. It is old as history and the farmer apparently is slow to associate the tenets of modern science with the teachings of ancestral experience. For the automobiles (whether for passengers or goods), the tractor, manufactured nitrates, hard-surfaced roads and electric power the farmer is compelled to look to engineers and the engineering industries. This is true also even for farm sanitation. Thus engineering has contributed much to the convenience of farm life, but the farmers have adopted the improvements rather unrestrainedly and are suffering in consequence.

For example, is the farmer being misled by the many times repeated statement that our tremendous expenditures for hard-surfaced highways are being made for his benefit; and, even if it is good "politics" now, is it ethically right to spend from ten thousand to thirty thousand dollars a mile for secondary highway networks when half the money might serve the particular purpose and any money for the purpose has to be raised by difficult taxation? Until we engineers as individuals and as civic groups can correctly answer these and many similar questions which are essentially of engineering applications that influence convenience of life in the rural areas and profoundly affect the economic condition of the residents of these areas, we will not have discharged our old-time debt to agriculture.

If our inventions available for contributing to convenience and welfare in the rural regions are misused, engineers may deny responsibility and liability; but if we should take that attitude we would be fixing on ourselves the purely secondary place of surveyors of physical possibilities in machines and struc-

tures, and of designers and constructors, and we would be leaving to others the primary place of authority for determining whether such machines or structures shall be produced and used in any particular situation. I do not believe that we are satisfied to occupy the secondary place solely, and we will therefore cultivate a fuller understanding of the relations held by engineering machines and structures to human relations and progress, in order that we may not only plan, design and build but may also hold a proper part in determining the objectives for doing so. In taking this attitude we must acknowledge that many of the origins of the future engineering, such for instance as relate to further agricultural development, are as yet to be established, notwithstanding that fifty centuries of continuing origination and development have been devoted to engineering as it now exists.

The community of interest which arises from integration of groups of people develops the qualities of civilization. Civilization takes on new aspects as the integration of communities follows in the wake of the great inventions which either make personal relations important for comfort and convenience or make such relations easier to secure and at the same time lift burden from individual muscles. The material and physical aspects of the civilization (which aspects we call political economy or economics) are in constant flux as scientific discoveries increase the possibilities of physically comfortable living, because of the increasing emphasis laid on mental activity *versus* man's muscular activity. The intellectual aspect of civilization, which we call culture, also widens as civilization widens. The shift of conditions in each human age has made preparation for the next age, so that it is often difficult to distinguish the relative importance of impressively influential inventions of successive ages. For example, was the eye-pierced needle capable of being used with cotton thread or the saw-like cotton-gin the greater invention?

We may thus observe that up to this generation we have not uncovered all the primary origins of engineering as they are likely to become disclosed by the farther progress of agriculture. Moreover, this is true notwithstanding the many tens of centuries since primitive man discovered the mechanical elements and his successors found convenience from applying them to the homely problems of raising water for irrigation, of winnowing grain and other now well-recognized agricultural processes. Therefore, as engineers, we have strong cause for giving thoughtful consideration to improvements of social organization and economic conditions in the agricultural regions.

It is now appropriate to seek the origins of engineering which have arisen and are arising through trade and transportation. Sailing and rowing ships are of great antiquity. Archeological remains indicate that there were ships on the Tigris and Euphrates 4,000 years before the Christian Era. Development of harbors was a gradual outcome of commercial trade carried on by water. It is impossible to say when formal highways (as distinguished from mere trails) were first constructed and maintained, but the date apparently should be assigned to lesser antiquity than hydraulic works. Bridges naturally followed with formally constructed roads. Indeed in some instances the bridges have been more permanent than the roads, as is illustrated by certain ancient examples in China. A modern instance where sound economic reasoning leads to like results is to be observed in Turkey, where permanent bridges are being established over some of the rivers, although the money is not yet available to convert the old part-year cart roads into satisfactory automobile highways. This is for the purpose of making the present roads available for traffic in certain seasons when rivers are in spate and still have adequate bridges in place when the roads have been rebuilt.

The seeds of civilization were sown when men who possessed like objectives first purposefully gathered together in communities. Those seeds germinated and the tree of civilization flourished and grew in influence as engineering expanded in scope and competent means for intercontact between the communities increased. However, as long as the horse continued to be the most serviceable message-runner, burden-bearer and draft animal, moderns had but little advantage over the ancients. Differences between specific earth roads and differences between strains of horses were but moderate differences between likes. Water-borne trade provided a difference in kind which profoundly affected ancient peoples. Heat-power motive devices equally profoundly distinguish our period from the conditions of a few centuries ago. While the invention of the wheel is lost in the dark of prehistoric time and the runner and courier as messengers of communication go back as far as we know, our own methods of transportation by heat-power on land and water and in the air and our methods of communication by electricity are recent revolutions and have introduced extraordinary economic changes. Stationary steam power and formally established factories alone would not have done so.

Ethnologists tell us that a common language is not necessary for family life and relations. This may be true; each one can find out by trying it on her husband or his wife; but, broadly speaking, a common language is needed for relations in a community of many individuals. The need is also particularly felt in the casual contacts of individuals made for commercial trade. Out of this need the spoken languages

of the world doubtless were developed. Organized language must have greatly facilitated and increased trade, and thus the germs of ship engineering, harbor engineering and production engineering were fertilized to farther growth by those who felt advantage for themselves to be derivable from the growth of trade. Community concentration also became more notable as a consequence of the trade growth.

An emphatic demand for engineering structures and machines followed in the wake of community concentration. A convenient water supply for man and beast came into demand. Removal of offal became a demanded sanitary convenience. Better roadways were demanded so as to meet the convenience of the many citizens. Surveys of land boundaries were contributory to preserving order. Engineering experience and skill came under constant requisition and were enlarged by practise. The results of improved engineering skill made concentrated populations less uncomfortable, with a reflex result that urban populations continued to concentrate. City planning seems to be a rather old profession. It goes back at least 3,000 years in the East, and it still is adding new facets because of new discoveries in science and political economy in the West.

Thus we see that in each activity of life where structures or machines could be made serviceable for gaining convenience, they were given early attention. The dexterity of man from ages back is illustrated from the remark in the Book of Judges that, of a chosen 700 left-handed men, "every one could sling stones at an hair-breadth and not miss." Dexterity being established, the mental effort required to avoid physical inconvenience led to invention.

Inventions of structures or machines arise from applications of the mind to conceiving measures for modifying an existing situation or creating a new one. The practise of invention therefore is subsequent in time to the development of reasoning powers in man and coordinate with the application of mind to social organization. Social organization proceeds hand in hand with scientific discovery and invention, although the former may at times seem less lively in its forward steps than the latter. Invention also involves experimentation by which the conception is built up into a physical embodiment. Moreover, it involves the intellectual courage required to try again when a first embodiment has failed, and to try still again and again if need be after thoroughly reviewing and verifying the reasonableness of the conception. With the main stem of the human race reaching back a quarter of a million years, and brain volume as large as modern man's going back at least several tens of thousands of years, as anthropologists seem to have convincingly shown, there has been a long time for the more mentally active men who hated inconvenience to exert themselves in invention, but the early steps were founded on little experience and were crude. Full stride has only been reached in modern centuries. But through it all, the inventors of these improvements used intelligence to save exertion of muscles.

The very early period in which the urge of convenience affected at least a few of the human race is seen in a few flint implements or tools of a thousand centuries ago which were chipped to fit the using hand, although the proportion of early tools so fitted proves to be small. In contrast, a very modern illustration of man's propensity to shift muscular labor onto the machines comes from our American use of the automobile. Before the citizens of rural regions became addicted to automobiles, the rough-surfaced and rutted roads wound around the hills with curves and grades over which draft animals picked their way without much exertion of physical effort being required of their leisurely or somnolent drivers. Driving an automobile over those roads required continuous exertion of muscular effort. With the advent of automobiles as a rural transportation agency a demand widely arose for the abatement of this muscular effort. Therefore by the intervention of steam shovels, scrapers and steam rollers the hills have been cut through, the routes straightened and the surfaces made smooth so that drivers may tool along at ease.

Division of manual labor in the sense that Adam Smith used the term "division of labor" was not new in his generation but had existed over a long period of time. He brought it formally to the intellectual consciousness of scholars. Division of labor still exists and presumably will exist as long as man is called upon to do either manual or mental labor. The thing that is new in our day is *adaptation of labor* to the conditions wherein machines are used to shift the heavy labor from the muscles of individual men. Along with this adaptation goes a greater emphasis on intellectual power, and hence the origination of still further features of engineering. With the increasing emphasis of intellectual power there also has arisen a joy of achievement available to each individual which transcends the simple grubbing after food and other keep.

In war, necessity perhaps is the mother of invention, with the object of self-protection, as in the production of weapons or planning fortifications; but in pacific life the craving for relief for the muscles and for leisure free from heavy labor has been the stimulus for active-minded men to make the revolutionary, basic inventions. It was not necessity that drove Watt's engineering mind to the steam-engine, or George Stephenson's to the steam railroad, or Fulton's to the steamboat, and so on for the series of primary

inventions. Even the easiest, and therefore ranked as best, methods of hunting and fishing probably were invented by relatively active-minded men anxious to secure their food with greater ease.

Since the middle of the nineteenth century, for the first time in the world's history, we of the Western world have been in command of knowledge, skill and natural resources sufficient to produce comfort and satisfaction for every one. Our deficiency is lack of effectiveness in our applications of knowledge and skill. This is a conjoint problem of political economy with engineering and opens up possibilities of new threads for engineering. Indeed, every newly discovered fact in science or political economy may disclose the origin of a new thread in the fabric of engineering. That aspect of engineering which primarily arises from a recognition that the dignity and power of the human mind makes it appropriate to relieve man-labor by machine-labor in drudge work is only now crossing the threshold of its origin. This aspect requires for its correct development all the facts that can be discovered in political economy, just as the older aspects of engineering have needed and have utilized all the facts available from the discoveries in natural sciences.

The solution of the conjoint problem of engineering and political economy which is required to provide for men the craved advantages of convenience and leisure can only be secured by applying the same exacting, unremitting and critical research as has characterized the unfolding of physical science. Much reflection on the question as to where such research can be established, with firm expectation that results suitable to the conditions in this country may be realized, leads me to the answer that certain of the engineering faculties of the educational institutions of the country will have to be relied on. If we in this country are to enlarge and more uniformly distribute our comforts and conveniences, we must rely on ourselves for developing sound tenets of political economy, extending scientific research, encouraging invention, and improving conditions for the production and also the distribution of industrial and agricultural commodities.

We treat our machines with the same lack of consideration and manners as we exhibit toward fellow men. Millennia of experience with domestic animals have taught the human race that considerate use of such animals contributes to their safe serviceableness for their masters and avoids injury to neighbors; but bulky and elaborate machines are relatively new to human generations, and experience has not yet borne in upon man the most economical and fruitful manner of using his machine creatures. Some guiding restraints are needed here, so as to avoid certain social disadvantages. The use of machinery obviously has forced a degree of mitigation of the *laissez-faire* philosophy of Adam Smith, Ricardo and John Stuart Mill, with its bitter "hire-and-fire" policy, but this is not sufficient to meet all the needs. We can not afford to retard the further development of engineering; but the results of untamed scientific discovery and invention must not be allowed to bear with cruelty on individuals or communities. The nation now seems conscious of the latter truth, but it will require some legislative procedure before the desirable end can be secured, and this procedure needs guidance by ripened intelligences of those who are experienced with the control of machines and structures.

The growth of civilization goes hand in hand with adventure of the mind, just as advance of science is a child of the spirit of inquiry. Thus civilization and science have a bond of romance, and engineering is an agent by which civilization profits from science. Civilization connotes harmonious cooperation of many human beings, and also mutually sympathetic, helpful and elevated relationships. Civilization expands with the engineering arts because the latter enable groups of people to become closely associated without sacrificing either convenience or major comforts. Only preventive medicine can vie with engineering in importance to civilization; but medicine is a later flower borne on the branches, rather than a root of civilization.

Like a banyan tree, civilization profits from additional roots as it becomes more and more effectively spread, and the origins of new aspects of engineering are continually arising from the new roots. The primary engineering inventions of great influence on civilization which have originated in the last century and a half include no less a series than adaptation of steam power to general use, steam-power transportation by land and water, automobiles associated with hard-surfaced roads, electric power generation and distribution, artificial lighting by electricity, electric communication by telegraph and telephone, air navigation, chemical production on factory scale, adaptation of mineral fuels to general use. These by no means exhaust the possibilities, and new origins of engineering may reside in each new discovery in natural science and almost surely will be found to reside in each new proved tenet of political economy.

Inventions of tens of centuries back were, for their day, of corresponding influence on the then civilization as the inventions of our day on our civilization. Witness the Roman roads which tied Western Europe together by one transportation network. Modern automobiles and associated hard-surfaced roads, while similar in some aspects, are so different in conception

from anything within the reflections of a Roman leader that this modern development must be ascribed to its own modern origin. The outcome of some of the modern origins of engineering is nowhere seen more strikingly than in household affairs. Instead of skinning (by the exertion of main strength aided with crude tools made of chipped stone) the wild boar brought in on the back of her brute of a man, and burning the laboriously recovered meat over the open fire at the mouth of her cave, the woman of the dwelling now preserves her cherished rugs by passes of the vacuum cleaner, supervises the electric sewing machine, the electric washing machine, the electric mangle, and sets the temperature regulator for the oven of the gas or electric cooking-range. Thus, the practicable life of the house-woman has been revolutionized as an outcome of scientific discovery and invention and become one of light but highly skilled labor associated with physical and mental freedom and available time for reflection, recreation and not uncommonly for special service to society. Another homely but graphical example which serves to illustrate changes in only fifty years that have resulted from engineering of modern origins is the group of automobiles quiescently awaiting their worshipping masters around the country churches of a Sunday, where horses (with their buggies) formerly stood in fly-pestered impatience.

It is my hope that the foregoing sketch has convinced you that the origins of engineering lie in man's knowledge of the forces of nature and their application to man's convenience. Each fact discovered regarding those natural forces carries its own possibilities of useful application, and as the facts have been detected and identified with the course of time the scope of engineering has been correspondingly widened until it now possesses a very comprehensive influence on human life.

Man wishes to secure protection from the weather (that is, shelter and clothing), plenty of satisfactory food, safety for his person, sociable contact with his kind, and comfort in all his affairs. Engineering contributes to satisfying all these desires. It is worthy of the fullest development for the purpose of enlarging this influence. As science discloses the facts, engineering is able more fully to meet these desires in substantial degree for every one. Engineering is thus an inextricable thread in the fabric of the civilized world's social organization. Natural phenomena are not all understood; the facts have not yet all been observed and new ones are detected from day to day. Out of each one of these may spring new origins for engineering processes, and the scope of engineering may be expected to expand as long as man remains mentally of investigative character and corporally with a fondness for convenience.

SCIENTIFIC EVENTS

THE SOIL EROSION SERVICE

AMONG the numerous activities of those now enrolled under the Civil Works employment plan, it is reported from north-central Missouri that a group of 163 men are building rock dams across destructive gullies and mining limestone to correct soil acidity. These men are employed on a 200,000-acre erosion control project being carried out in the rolling part of the Missouri-Iowa corn belt by the Soil Erosion Service of the Department of the Interior.

The continuing destructive effects of soil washing in this extensive region of highly productive corn land has already largely stripped off the fertile topsoil from four and a half million acres. Nearly half a million acres have been essentially destroyed by gullying. These lands were all cultivated at one time, producing in good years around 75 bushels of corn per acre. Now much of this eroded land will not yield more than 15 or 20 bushels per acre, and in dry years the yields dwindle to nothing.

It has been shown at the soil erosion experiment station in this region that land sloping about eight feet in a hundred loses every year in the neighborhood of 85 tons of soil an acre, where continuously planted to corn. According to measured results 35 per cent. of all the rain runs off into the streams under this unwise system of land use. Where alfalfa is grown, on the other hand, the soil losses from the same kind of land are less than two fifths of a ton per annum, and the runoff of rainfall amounts to only 2 per cent. of the total precipitation. Clover and timothy are also effective in controlling erosion and runoff in this region.

In order to produce a good crop of clover or alfalfa it is necessary to "sweeten" the soil by applying ground limestone rock. The crushed rock will be scattered over the steeper sloping areas, which are to be planted with clover, alfalfa and various grasses. Erosion-control treatment will be applied to every acre of land over the 200,000-acre watershed in accordance with its particular needs.

Part of the Civil Works force now engaged on this project is making use of rocks and brush to close up the gullies which have been steadily cutting to pieces the sloping lands. The specialists of the service assert that men could not be put to more useful work, for the reason that, regardless of crop surpluses, the nation can not afford to lose any more of its high-

powered agricultural land, such as these rich prairie soils. It is recognized by the erosion specialists that many millions of acres of land now in cultivation are so steep and erosive that it is futile to continue their use along lines of present agricultural practise. These lands must be taken out of the clean-tilled crops, under which wastage of soil by erosion is most rapid. They must either be planted to trees or soil-saving, thick-growing crops, such as alfalfa, grasses and clover, or protected from grazing long enough for voluntary growth of weeds and grasses to take care of the problem.

THE TENNESSEE ACADEMY OF SCIENCE

THE thirty-third meeting of the academy was held on Friday and Saturday, December 1 and 2, at the George Peabody College for Teachers, Nashville, Tenn. Discussion of the Tennessee Valley Development was the chief feature of the meeting. A symposium on "The Tennessee Valley Development Project" constituted the program for the Friday afternoon session, as follows:

"The Geological Phases of the Project," by Dr. Walter F. Pond, state geologist, Nashville.

"Transportation and Other Geographical Problems," by Dr. Albert E. Parkins, George Peabody College.

"General Engineering Features," by Professor Fred J. Lewis, Vanderbilt University.

"Agricultural and Sociological Aspects," by Dr. Kary C. Davis, George Peabody College.

The subject of the academy address on Friday evening, by Dr. Walter D. Cocking, Tennessee state commissioner of education, was "The Educational Implications of the Tennessee Valley Authority."

At the business meeting on Saturday, amendments to the constitution and by-laws were adopted, providing for the management of the Reelfoot Lake Biological Station by a director and a board of trustees chosen by the executive committee.

Resolutions were adopted approving the presentation of the Tugwell bill for adequate control of the advertising claims and the contents of proprietary medicines, and the general plans for the development of the work of the Tennessee Valley Authority and its freedom from political guidance and its efforts toward enlivening the social order and improving the industrial, natural and educational resources of the South.

The president, Dr. Francis G. Slack, presided at the sessions on Friday morning and afternoon, and the vice-president, Dr. Charles W. Davis, on Friday evening and Saturday morning.

Officers for the year 1933–1934 are:

President, Walter F. Pond, Tennessee state geologist, Nashville.

Vice-president, George M. Hall, professor of geology, University of Tennessee, Knoxville.

Secretary-treasurer, John T. McGill, professor emeritus of organic chemistry, Vanderbilt University, Nashville.

Editor, Jesse M. Shaver, professor of biology, George Peabody College, Nashville.

The librarian is Miss Eleanor Eggleston, Vanderbilt University. Dr. A. Richard Bliss, Jr., director of the research laboratories of the William A. Webster Company, Memphis, will be the director of the Reelfoot Lake Biological Station. The secretary-treasurer of the academy, Dr. John T. McGill, was elected to represent the academy at the meeting of the American Association for the Advancement of Science, Boston, December 27, 1933. The spring meeting of the academy for 1934 will be held at Knoxville.

THE WORK OF PROFESSOR WILLIS LINN JEPSON

PROFESSOR WILLIS LINN JEPSON, of the department of botany of the University of California, was recently appointed faculty lecturer for 1934.

Professor Jepson is a native of California and an alumnus of the University of California, having been born in Vacaville, on August 19, 1867, and having rereceived the degrees of bachelor and doctor of philosophy in 1889 and 1899. His first appointment to a teaching post came in 1891, when he became a student assistant in the university.

In announcing his appointment the academic senate outlined his contributions as follows:

Beginning as a boy, and later under Edward Lee Greene, he has devoted himself to a study of the flora of California. He established the journal *Erythea,* for the expression of ideas and discoveries in California botany. He has published innumerable shorter articles dealing with various aspects of the botany of the state, taxonomic, morphologic and distributional. His more considerable contributions began with his first edition of his book, "Flora of Western Middle California." His next undertaking was to bring together the flora of the entire state, which meant a laborious monographic study of every genus of flowering plant in the state. Outstanding in this series of monographs were those on Allium, Eriogonum, Arctostaphylos, Godetia and the family Umbelliferae. His work on the genus Eschscholtzia is regarded as a classic in the handling of difficult polymorphic genera. The preliminary draft of these studies resulted in the publication of the "Manual of Flowering Plants of California." Meanwhile, the monographic work has been appearing in parts, as "The Flora of California." This work is still going on, and although a considerable number of parts have been published, the manuscript already prepared and awaiting publication will greatly extend this monumental work.

Professor Jepson has concerned himself not only with the flora of California in general. His name will ever

be associated among both scientists and naturalists with his studies of the trees of California. His elaborate and consummately executed book "Silva of California," published as a memoir in the botanical series of the University of California, is recognized as an outstanding masterpiece of systematic botany. The two editions of his smaller work, "The Trees of California," have, however, been even more instrumental in aiding an increasing number of persons to acquire a knowledge of this part of the state's plant life.

The breadth of view-point exhibited in his taxonomic work has given Professor Jepson a high rank among American botanists. He is a member of several botanical societies and has been honored by elections to the American Academy of Arts and Sciences and the National Botanical Society of Czecho-Slovakia. He has been an active promoter of forest conservation, and has been for many years a counselor of the Save the Redwoods League. He is known to every amateur botanist and plant lover in the state.

THE RETIREMENT OF DR. BEVERLY T. GALLOWAY

DR. BEVERLY T. GALLOWAY, who retired recently from the U. S. Department of Agriculture under the age limit clause, is not planning to retire from active research. He, like several other scientific men similarly retired, plans to continue research, especially the broader aspects in relation to new crops, their diseases and utilization under changing economic conditions. He will divide his time between headquarters in the Bureau of Plant Industry in Washington and his winter home on a small tract in Florida, where he will devote particular attention to new plants of value to Florida and the South.

Dr. Galloway was appointed to the department in 1887 and has served continuously—with the exception of two years—in research and administrative posts. He was largely responsible for the creation of the Bureau of Plant Industry from several independent divisions engaged in plant research and was chief of the new bureau from 1901 to 1912. In 1913–14 he was assistant secretary of agriculture and was then dean of agriculture at Cornell University for two years, returning to the department in 1917.

Dr. Galloway, primarily a research worker, was frequently drawn into administrative activity, and repeatedly was called on to assist in formulating and guiding the research and extension policies of the department. Under Secretary James Wilson he guided the legislative and related movements for new buildings, resulting finally in the erection of the East and West wings and plans for a central structure and additional wings practically as now being constructed.

Appointed as assistant plant pathologist in 1887, Dr. Galloway became chief of the Division of Vegetable Physiology and Pathology the following year. In 1900, when William Saunders died, Dr. Galloway succeeded him as chief of the Division of Gardens and Grounds. In the course of his administration he helped to start in the Bureau of Plant Industry the work in farm management and marketing which later grew into the Bureau of Agricultural Economics.

As Assistant Secretary of Agriculture under Secretary Houston in 1913–14 he was regarded as an able administrator and was responsible for improving the working organization of the department. After his return to the department in 1917 he continued in research work, particularly investigations of the pathological aspects of the introduction of new plants.

AWARD OF THE COPLEY MEDAL OF THE ROYAL SOCIETY TO PROFESSOR THEOBALD SMITH

AT the anniversary meeting of the Royal Society, London, on November 30, the award of the Copley Medal was made to Dr. Theobald Smith, emeritus member of the Rockefeller Institute. The medal was presented by Sir Frederick Gowland Hopkins. We take from *Nature* an extract from his remarks:

"Professor Theobald Smith was director of the Department of Animal Pathology of the Rockefeller Institute for Medical Research, Princeton, N. J., from 1914 until 1929. In 1886 with Professor Salmon he showed a new method for producing immunity from contagious diseases by inoculating with a dead bacterial vaccine killed by heat, thus advocating a principle which was re-discovered fifteen years later and has been widely used, notably for making antityphoid vaccine. In 1889 he discovered the first known instance of a disease of vertebrates transmitted by an arthropod—Texas fever of cattle due to a protozoon transmitted by a tick. He introduced differential tests for bacteria based on their biochemical action. In 1896–98 he clearly, and for the first time, distinguished between the human and bovine types of *Bacillus tuberculosis* and the forms of disease which they produce, anticipating Koch's pronouncement in 1901.

"In 1903, with Reagh, Professor Smith described the non-motile variants of certain pathogenic motile bacteria and their important serological differences. He discovered in 1904 the remarkable phenomenon known as anaphylactic shock in the guinea pig. In 1926 he discovered the very potent effect of the colostrum, the first milk of cows, in protecting calves from certain severe infections. He also made other notable original observations, such as those on the growth and toxin production of the diphtheria bacillus, and on the production of immunity by mixtures of toxin and antitoxin; he also described disease of the cow's udder communicable to man by the milk."

SCIENTIFIC NOTES AND NEWS

THE annual meeting of the British Association for the Advancement of Science will be held next year in Aberdeen from September 5 to 12 under the presidency of Sir William Hardy, F.R.S. The following sectional presidents have been appointed: Section A (Mathematical and Physical Sciences), Professor H. M. Macdonald; B (Chemistry), Professor T. M. Lowry, C.B.E.; C (Geology), Professor W. T. Gordon; D (Zoology), Dr. E. S. Russell; E (Geography), Professor A. G. Ogilvie; F (Economic Science and Statistics), Professor H. M. Hallsworth, C.B.E.; G (Engineering), Professor F. G. Baily; H (Anthropology), Captain T. A. Joyce; I (Physiology), Professor H. E. Roaf; J (Psychology), Dr. Shepherd Dawson; K (Botany), Professor A. W. Borthwick; L (Educational Science), Mr. H. T. Tizard, C.B., F.R.S.; M (Agriculture), Professor J. A. S. Watson. The president of the Conference of Delegates of Corresponding Societies will be Colonel Sir Henry Lyons.

DR. JAMES BRYANT CONANT, president of Harvard University, received the degree of doctor of laws from the University of Chicago at the close of the one hundred and seventy-fourth convocation on December 19. The degree was conferred by President Robert M. Hutchins "in appreciation of Dr. Conant's eminent service to the science of chemistry and in recognition of his position of leadership in American education." Dr. Julius Stieglitz, professor emeritus of chemistry at the University of Chicago, presented Dr. Conant for the degree.

DR. WILLIAM H. WILMER will retire on July 1 from the directorship of the Wilmer Institute of Ophthalmology of the Johns Hopkins Hospital on reaching the age limit of seventy years. Dr. Wilmer expects to continue his research work and his private practise. The institute was founded in 1925 with an endowment of $3,000,000, largely the contributions of Dr. Wilmer's former patients.

IN honor of Dr. Frank Burr Mallory, professor of pathology, emeritus, in the Harvard Medical School, the Mallory Institute of Pathology has been organized at the Boston City Hospital. It was dedicated on Wednesday, December 13.

DR. GEORGE J. PEIRCE has retired from the chair of botany at Stanford University with the title of professor of botany, emeritus. Dr. Peirce has been connected with Stanford University since 1897, when he was appointed assistant professor of botany.

ON the occasion of his seventieth birthday, Dr. Arthur Dehon Little on December 15 was presented by his staff with a specially bound and inscribed volume of the Morse Collection of Japanese Potteries. The presentation was made by Mr. Roger C. Griffin, director of tests and a member of the Board of Directors of Arthur D. Little, Inc. Mr. Griffin is a son of Mr. Roger B. Griffin, Dr. Little's original partner when the organization was formed as Griffin and Little in 1886.

THE degree of doctor of science has been conferred by Georgetown University on Dr. James Robertson, director of the Nautical Almanac office of the U. S. Naval Observatory, in recognition of his work in theoretical astronomy.

THE William Lawrence Saunders Gold Medal of the American Institute of Mining and Metallurgical Engineers, for distinguished achievement in mining, has been awarded for the year 1934 to Pope Yeatman, consulting mining engineer of New York City.

THE presentation of the Perkin Medal of the Society of Chemical Industry to Professor Colin G. Fink, of Columbia University, will be made at a meeting to be held jointly with other chemical societies on January 5, at 7:30 P. M., at The Chemists' Club, New York City. Professor Harold Hibbert, of McGill University, will give a short talk on the subject of "The Medalist and His Accomplishments," and Professor Marston T. Bogert, of Columbia University, will make the presentation. Dr. Fink will present an address entitled "Chemistry and Art." A dinner preceding the meeting will be held at the club at 6 o'clock. All interested are invited to attend the meeting, even if not members of one of the cooperating societies.

Nature states that Dr. Ian W. Wark has been awarded the H. G. Smith Memorial Medal for 1933 by the Australian Chemical Institute. The medal is presented annually to the research worker who, in the opinion of the council, has contributed the most valuable additions to chemical science in Australia during the previous ten years. For the past four years, Dr. Wark has been investigating, for a group of mining companies, the theoretical basis of the flotation process for the concentration and separation of minerals. His work has also been recognized by the University of Melbourne, which awarded him both the Syme and Grimwade Prizes for 1933.

ACCORDING to *Nature,* Sir James Frazer has been offered a grant of £400 a year for three years by the Drapers' Company, as a mark of the company's recognition of his conspicuous contributions and distinguished services to science and to literature, for the purpose of providing himself with such expert secretarial assistance as will enable him to continue the scheme of work on which he has recently embarked

and which, by reason of his failing eyesight, he might otherwise be unable to complete.

PROFESSOR H. S. RAPER, Brakenbury professor of physiology in the University of Manchester, has been appointed a member of the British Medical Research Council in succession to Professor Edward Mellanby, who recently resigned his membership on accepting appointment as secretary of the council.

GOVERNOR HERBERT H. LEHMAN, of New York State, has asked Dean Carl E. Ladd, dean of the New York State College of Agriculture of Cornell University, to organize and to act as chairman of an Agricultural Advisory Commission. The governor announced that he had acted at a suggestion of the Farm Credit Administration that a State Farm Department conciliation committee be set up. The committee will in turn appoint county committees "to cooperate with the activities of the Federal Farm Credit Administration in the relief of farm debtors who are in distress and in danger of losing their farms."

PROFESSOR W. B. HERMS, head of the division of parasitology and entomology in the College of Agriculture at the University of California, has been appointed director of Pest Mosquito Control for the state of California, under the Civil Works Administration. For this work there will be employed 1,650 men and 34 supervisors. The project is being directed from the Bureau of Entomology of the U. S. Department of Agriculture, of which Lee A. Strong is chief.

DR. JACOB G. LIPMAN, dean of the college of agriculture of Rutgers University, has been appointed municipal director of emergency relief for the city of New Brunswick and the borough of Highland Park, N. J.

PROFESSOR MARSTON T. BOGERT, head of the department of organic chemistry at Columbia University, has been appointed a member of the Board of Directors of the Florida Research Institute, whose headquarters are at Eustis, Florida.

CHESTER C. DAVIS, who organized the Montana State Department of Agriculture, has succeeded George N. Peek as agricultural adjustment administrator of the Federal Government.

REPRESENTATIVES of the Rockefeller Foundation, Dr. Paul F. Russell, of the Field Staff of the International Health Division, and Dr. Victor G. Heiser, associate director, Professor W. W. Jameson, dean of the London School of Hygiene and Tropical Medicine, and Dr. Fitzgerald, dean of the Toronto Medical School, will arrive in Colombo on January 4 and will visit, among other places, Madras, Calcutta, Delhi and Bombay. The object of the tour is to study various public health problems in which the foundation is interested, and gain some first-hand knowledge of medical work in India.

DR. JOHN BEATTIE, for the last six years associate professor of anatomy at McGill University, who was recently appointed to succeed Sir Arthur Keith as conservator and director of research of the Royal College of Surgeons, London, sailed for England on December 14.

DR. HOWARD T. KARSNER, professor and director of the Institute of Pathology of the School of Medicine of Western Reserve University, delivered the Smith-Reed-Russell Lecture at the School of Medicine of George Washington University, Washington, D. C., on December 19. He spoke on "Rheumatic Heart Disease."

DR. J. PARSONS SCHAEFFER, professor of anatomy of the Jefferson Medical College, gave an address on December 14 before the Thomas C. Porter Scientific Society of Franklin and Marshall College, on "The History and Legal Aspects of Practical Anatomy."

DR. GEORGE F. REDDISH, chief bacteriologist of the Lambert Pharmacal Company, of St. Louis, addressed the Sigma Xi Club of the Massachusetts State College on December 14 on "Antiseptics and Disinfectants."

DR. ROBERT M. BURNS, assistant chemical director of the Bell Telephone Laboratories in New York, will speak at the Carnegie Institute of Technology, Pittsburgh, on January 26 on "The Corrosion of Metals."

DR. FREDERICK C. LEONARD, chairman of the department of astronomy of the University of California at Los Angeles and president of the Society for Research on Meteorites, gave an illustrated lecture on "Visitors from Cosmic Space" before the Astronomical Society of Pomona College on the evening of December 8.

THE Bradshaw Lecture of the Royal College of Surgeons was delivered by Professor A. H. Burgess on December 14 on "Electro-surgery."

IN January, 1934, Professor Reginald Aldworth Daly, Sturgis-Hooper professor of geology at Harvard University, will deliver a series of lectures on the Hepsa Ely Silliman Foundation at Yale University entitled "Planetary Changes in the Ice Age." Professor Daly will deliver eight lectures, as follows: "Ice-caps Past and Present," "Recession of the European Ice," "Recession of the North American Ice," "Mechanism of the Earth's Deformation and Recoil," "High Sea-levels of the Ice Age," "Low Sea-levels of the Ice Age," "Coral Reefs and the Ice Age," "Survey of the Field." The first lecture will be given at 4:15 P. M., in Strathcona Hall, on January 22. Succeeding lectures will come on January 23, 24, 25, 26, 29, 30 and 31.

IT is proposed to recognize, by some form of useful memorial, the distinguished work of Professor Sir Edward Sharpey Schafer, who recently retired from the chair of physiology at the University of Edinburgh. The suggestion that meets with most favor is the establishment of a lectureship to be called "The Sharpey Schafer Lectureship in Physiology." Under this lectureship one lecture would be given annually (or biennially) in Edinburgh by a distinguished physiologist to be selected by the Faculty of Medicine. For this purpose a capital sum of approximately one thousand pounds is required, and subscriptions to the fund, limited to a maximum of five guineas each, are invited. The appeal is signed by the following: William Johnston Thomson, Lord Provost, City of Edinburgh; Sir Thomas Henry Holland, vice-chancellor, University of Edinburgh; Sir John Rose Bradford, University College, London; Sir Henry Hallett Dale, director, National Institute for Medical Research, and secretary, Royal Society; John Wheeler Dowden, president, Royal College of Surgeons, Edinburgh; John Scott Haldane, fellow, New College, Oxford; Sir William Bate Hardy, director of food investigation, department of scientific and industrial research; Sir Frederick Gowland Hopkins, president, Royal Society and British Association; Sir Thomas Hudson Beare, dean of the Faculty of Science, University of Edinburgh; The Honorable Lord Sands, vice-president, Royal Society, Edinburgh; Sir Charles Scott Sherrington, professor of physiology, University of Oxford; Sydney Alfred Smith, dean of the Faculty of Medicine, University of Edinburgh; Robert Thin, president, Royal College of Physicians, Edinburgh, and Arthur Logan Turner, president, Graduates' Association, University of Edinburgh.

THE *Journal* of the American Medical Association reports that the eightieth birthday, November 26, of Dr. Karl Sudhoff, professor emeritus of the history of medicine, University of Leipzig, was commemorated, November 27, by members of the Johns Hopkins Medical History Club, in the lecture hall of the Welch Medical Library, Baltimore. Papers on the life and work of Dr. Sudhoff were read by Drs. Henry E. Sigerist, professor of the history of medicine, the Johns Hopkins University Medical School; Fielding H. Garrison, librarian of the Welch Medical Library and lecturer in the history of medicine; John R. Oliver, associate in the history of medicine, and Owsei Temkin, associate in the history of medicine. An exhibit of the work of Dr. Sudhoff was on display. Dr. Sudhoff was director of the Institute of Medicine at the University of Leipzig from 1905 until his retirement in 1925, when he was succeeded by Dr. Sigerist. He practised in Germany more than thirty years, was a Prussian sanitary councilor for four years, and was the first president of the German Society for the History of Medicine. He is known as a translator of Arabian and Egyptian hieroglyphics and ancient Hebrew texts. Dr. Sudhoff delivered an address at the dedication of the Institute of the History of Medicine at the Johns Hopkins University in 1929.

ACCORDING to *Nature* the annual conference of the Geographical Association will be held at the London School of Economics from January 3 to 6. The presidential address will be delivered by Professor P. M. Roxby, Rankin professor of geography in the University of Liverpool, on "China as an Entity—the Comparison with Europe." Lectures will be delivered by Professor J. D. Greene, Dr. J. H. Hutton, Professor G. C. Allen, Professor J. Coatman, Commander L. C. Bernacchi, Dr. S. W. Wooldridge, D. L. Linton and Professor Julian Huxley. Two discussions have also been arranged: for teachers in primary schools, on "The Place and Problems of Local Geography," to be opened by Mr. J. C. E. Rogers; for secondary schools, on "Suggestions for a First School Certificate Geography Syllabus," to be opened by Mr. J. A. Mortlock.

THE next annual convention of the American Association of Physical Anthropologists will be held in New York in the early part of May. It is being planned that the meeting should run concurrently with that of the American Society of Mammalogists, a joint session with that society having been proposed for papers dealing with Primates.

THE nineteenth annual meeting of the American Association of Petroleum Geologists will be held at the Baker Hotel at Dallas, Texas, March 22, 23, 24, 1934.

AT the recent annual meeting of the Royal Society, London, the council reported that the policy of appointing Yarrow research professors has been eminently successful, but that the financial position of the Yarrow Fund is such that no appointment of a successor to Professor A. Fowler on his retirement should be made until the income of the fund justifies the reconsideration of the appointment of a third Yarrow professor; and that any surplus available should be added to the Yarrow Reserve Fund with the view of aiding any special research for which money is urgently required.

THE plane and all the equipment used by Colonel and Mrs. Charles A. Lindbergh on their recent 30,000-mile survey flight, in which they crossed both the North and South Atlantic and visited twenty-one countries, has been presented by them to the American Museum of Natural History. The plane is the

same in which the Lindberghs established a new transcontinental record in April, 1930, and in which they flew to the Far East the following year. Until the proposed Geographical Hall is built the plane and its equipment will be installed in the Hall of Ocean Life.

The New York Times writes that on December 22 Rear Admiral Richard E. Byrd, "halting the southerly drive of his flagship along the 150th meridian, when the pack accumulating ahead seemingly threatened to bar further progress, ordered the ship to retreat a little to find open water, put his giant seaplane over the side and renewed the southern assault by air. Before he turned back the flight carried him to Latitude 70 degrees south, surpassing by 350 miles the record southing attained by Captain Cook on this meridian in 1773. The area of vision within the range of the plane, together with the corridor already opened by the flagship after it, too, had broken past Cook's track, brought to approximately 30,000 square miles the total amount of unexplored sea opened up by the expedition in its first operations."

DISCUSSION

NAMES FOR THE HYDROGEN ISOTOPES

IN a recent issue of SCIENCE, Professor R. W. Wood has suggested that the heavy isotope of hydrogen be named bar-hydrogen and suggests the symbol $\overline{H}$. He also further suggests that the compounds containing the heavy isotope be referred to as $\overline{B}$enzol, $\overline{A}$mmonia, and so forth. It is interesting that we considered exactly this name and symbol before we published the suggestion of the name deuterium for the heavy isotope, and protium for the light isotope. One difficulty with many of these names which has been overlooked by Professor Wood is that there are not two varieties of water, two of ammonia, two of benzene, and so forth, but there are three waters, four ammonias and thirteen benzenes. No matter what name is finally given to the heavy isotope, there will be no simple way of naming these complicated compounds. In fact, if there were only two waters, two ammonias, and so forth, the names "light water," "heavy water," "light ammonia" and "heavy ammonia" would be very satisfactory indeed.

The real difficulties arise when we try to name such compounds as H^1H^2, $NH^1H^2_2$, $NH^1_2H^2$, $C_6H^1_2H^2_4$, and so forth. Using the names suggested by us, these would be called protium-deuterium, mono-protium di-deuterium nitride, di-protium mono-deuterium nitride and tetra-deutero benzene, respectively. If we use the name bar-hydrogen, it will be necessary to devise similar rather complicated names for these compounds, and we really think, from the standpoint of simplicity, there is very little advantage to be given to one set of names over another.

Professor Wood objects to the treatment of the heavy isotope of hydrogen as a distinct element, but from our conversations with a number of organic chemists where this problem is the most serious, it appears almost necessary to name some of these compounds as though the deuterium were a foreign element. Thus the compound $CH^1_3H^2$ might be called deutero methane, just as the compound CH^1_3Cl may be called chloro methane. This method of naming does not place the two isotopes of hydrogen on the same footing, but regards the second isotope of hydrogen as a foreign element, but this will be true regardless of the name of the second isotope. Moreover, the name bar-hydro as a combining term for naming such compounds would probably be confused with the term hydro in common use. Perhaps the term bar-hydro would be contracted to bar or baro, in which case the combining term would be that which would naturally be derived from the name barogen, another name considered by us and frowned upon by our friends on whom we practised it. Because of these difficulties, we do not believe that there is any great advantage in Professor Wood's suggestion of bar-hydrogen over that of deuterium as a name for the isotope, and in fact feel that the name deuterium is better.

The question of a symbol for the heavy isotope is a troublesome one, and Professor Wood's suggestion has certain advantages. We may say that we have found it convenient to refer to the symbols of the compounds such as those written above, by agreeing to refer to the superscript first and the subscript second. Thus the compound $NH^1_2H^2_1$ can be read N, H, one, two, H, two, one. We have considered other suggestions for symbols, as, for example, the use of D for deuterium, but we have found that the formuda ND_3 for the ammonia containing the heavy isotope and similar formulae for other compounds do not appeal to us. After all, the heavy isotope of hydrogen is also hydrogen. Such a symbol as this has the disadvantage of making the heavy isotope of hydrogen a distinct element. We still think that the symbols H^1 and H^2 are the best choice because they fit into the general scheme of symbols for other isotopes. Recent work of Lewis indicates that the oxygen isotopes may be separated by distillation in appreciable quantities. What system of bars can possibly be devised to refer to the nine varieties of water? Little confusion will

result if we agree to read the superscript first and the subscript second, as suggested above.

HAROLD C. UREY
F. G. BRICKWEDDE
G. M. MURPHY

DEPARTMENT OF CHEMISTRY
COLUMBIA UNIVERSITY
AND
BUREAU OF STANDARDS

SUGGESTED NOMENCLATURE FOR HEAVY HYDROGEN AND ITS COMPOUNDS

THE suggestion of Professor Wood in the issue of SCIENCE for December 8 to designate heavy hydrogen atoms by the term "bar-" will not meet the complications which will arise when organic compounds of this substance are prepared. Thus 12 "bar-benzols" are possible, depending on the number of heavy hydrogen atoms in the molecule. It is almost inevitable that some special name will have to be given to the heavy hydrogen atom in order to incorporate that name in suitable form in the names of organic compounds. "Deuterium" would seem to be as good a name as any. In this laboratory we are much interested in the highly symmetrical molecule, neopentane (tetramethylmethane). "Bar-neopentane" might apply to any of 34 theoretically possible compounds. When we are successful in our attempts to make a neopentane containing one heavy hydrogen, we shall call it either "deutero-neopentane" or "neopentyl deuteride."

FRANK C. WHITMORE
THE PENNSYLVANIA STATE COLLEGE

LIGHTNING PROTECTION FOR TREES

ON page 507 of SCIENCE for December 1, 1933, there appears a discussion on lightning protection for trees by Professor J. B. Whitehead, which lays down four principles upon which Dr. Whitehead believes that scientists are generally agreed. Two of these principles are in such violent contradiction to the views of most present-day specialists on this subject that I think attention should be called to the matter. The two principles are stated as follows:

(1) The protective value of a lightning rod is in its ability to discharge continuously and so prevent an abnormal rise of potential gradient as related to an overhead cloud.

(3) The points of a lightning rod should be relatively sharp to permit steady leak and suppression of the high potential gradient.

Experiments upon a laboratory scale give some justification for the idea that the point discharge will prevent the building up of sufficient potential to cause a disruptive discharge. Upon the scale met with in nature, the point discharge appears utterly incapable to prevent such an upbuilding of potential, which often occurs in a very short time. Professor Whitehead recognizes that the many dozens of points on the top of the Washington Monument have been unable to prevent it from being frequently struck.

Most of those who have given considerable study to this problem recognize that the discharges from the points of lightning rods have little, if any, value in preventing a stroke of lightning, and that it is not important that the points should be sharp.

The National Fire Protection Association, the American Institute of Electrical Engineers and the National Bureau of Standards have had committees working on this problem for many years and a Code for Protection against Lightning has been produced, which has the approval of these bodies and also of the American Standards Association. The 1932 edition of this code contains the following statement:

The sole purpose of lightning rods . . . is to protect a building in case a stroke occurs, there being no evidence or good reason for believing that any form of protection can prevent a stroke.

The first principle stated by Professor Whitehead was at one time widely held but is now thoroughly discredited.

General experience with lightning rods indicates a high degree of protection. The differing opinion as to the value of the lightning rod now exists mainly in the minds of those who have not investigated actual experience with such installations. Failure to protect is usually found to follow failure in proper installation or maintenance. A typical cause of failure is a discontinuity in the conductor which makes connection to the ground.

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BRACHYCEPHALY AND GLANDULAR BALANCE

IN delving into ethnic geography, I have been struck by the fact that certain regions which have been breeding grounds of brachycephals are also conspicuous areas of endemic goiter. Searching further, I have found indications that certain other areas, conspicuous for brachycephaly, are reported as noticeably goiterous, although not included in the common lists.

It is common knowledge, moreover, that individuals who have removed from a non-goiterous to a goiterous area are much more subject to goiter than are the natives. Whether individuals of stocks which have resided in a goiter area for only a few generations are more subject to goiter than are auchthones, is not reported; but there are some indications that this is true. If so, certain other regions, agreeing in general character with goiter areas, but into which there

has been no recent immigration, may also be suspected of being potential goiter areas.

Adaptation to environmental conditions through natural selection is sufficiently well established. There is no great difficulty in assuming, tentatively, that a stock, glandularly maladapted to a given environmental condition, may become so in from fifteen to thirty generations. The selection may operate through decrease in fertility, or through greater mortality of adolescents; neither of which would be as operative in civilized as in uncivilized modes of life.

It is not credible that the only disturbance in individuals affected by endemic goiter is thyroid. On general grounds, it is rather to be assumed that the balance, or pattern, of the system of endocrine glands is disturbed. Growth is manifestly controlled by the endocrines; and the checking of growth is similarly controlled. That the head-form is a growth-characteristic has already been indicated by Wissler. It is possible, then, that brachycephaly is a result of glandular adaptation to an environment of a certain sort. This environment may be one which is characterized by iodine deficiency: the actual nature of the condition, however, is not important for the present point.

This assumption seems to clear up some of the problems of head-form. It complicates others. Where an ancient brachycephalic population is overlaid by a later dolichocephalic one, there may be an actual continuity of the stock. On the other hand, continuation of a brachycephalic type over a long period in certain areas would indicate a series of immigrations. The possibility that the assumption is true seems to me of far-reaching importance. The different Negro types in Africa and the different American Indian types would receive an interpretation differing from the conventional one.

In the case of immigrants into a goiter area, it would be suspected that long-heads would, on the average, be more susceptible than round-heads. There would not be a sharp separation on this point, however. I do not know of any report on goiter cases which would throw light on this point. Length of ancestral residence in a goiterous or potentially goiterous area would be the point of maximal importance.

When stocks adapted to goiter regions migrate into non-goiterous areas, they might or might not be maladapted to the new condition; but in either case the iodine factor (or whatever distinguishes a non-goiter area) might cause a change in the glandular pattern, and a lengthening of the head, among other changes in growth characteristics. Apparently, this change would proceed more slowly than the converse change, although Boas' investigations indicate that it may not be very slow.

There are other directions of investigation open, if our assumption is taken seriously. For example, psychologists are well aware that the feeble-minded class includes many different types, and that those of the same Intelligence Quotient or same Mental Age vary greatly in their actual intelligences as well as in other characteristics. Glandular bases for some of these types have been suggested. It would seem useful to have more complete anthropometric studies of the feeble-minded, with particular reference to cranial indices, which, however valueless ethnically, may turn out to be useful in the differentiation of these types.

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REPORTS

THE WORK OF THE WEATHER BUREAU. II

THE two most important recommendations of this committee are: (1) That provision be made at once for extending the so-called air-mass analysis method over the United States, through the cooperation of the Weather Bureau, the Army and the Navy, as outlined below. (2) That the whole system of recording and reporting meteorological data in aid of forecasting be consolidated under the Weather Bureau (except for the activities necessary to the Army and the Navy).

(1) During the last decade there has been very rapid progress in Europe in the development and general use of air-mass analysis methods. These require a knowledge of temperatures, humidities and pressures aloft as well as on the surface, but thus far no systematic attempt has been made to obtain at a given time upper-air measurements of these aerological conditions at a considerable number of stations scattered systematically throughout the country so as to make possible the drawing of a daily upper air map of the whole country similar to the surface maps now provided by the Weather Bureau. Hence, as a first step toward the general adoption of air-mass methods of weather analysis in the United States a network of aerological stations must be established at advantageous points throughout the country. The present pilot balloon network seems adequate. The number of these aerological stations for observing the temperature, humidity and pressure aloft should be increased to twenty or twenty-five. This might readily be accomplished through the cooperation of the Army and the Navy with existing Weather Bureau aerological stations, without greatly increasing present expenditures. This is possible because of the fact that the Army and the Navy are equipped with

planes, pilots and fuel and may make daily flights of the desired nature without exceeding their training budget.

The map, provided in Appendix A, indicates existing facilities which include those of the Weather Bureau, the Army, Navy and the Massachusetts Institute of Technology. This will serve as a foundation upon which to build an efficient aerological network. The Army and Navy stations are more or less fixed, but those of the Weather Bureau may be shifted to fill in the gaps. For this work to be effective the Army and Navy should conduct soundings with the Weather Bureau instruments in accordance with Weather Bureau instructions and as a definite routine.

One ascent daily from the aerological stations would be sufficient, the data obtained to be filed for transmission with weather map signals at a specified time. Early morning flights are preferable in order to avoid radiation effects as much as possible; however, on the Pacific Coast this might prove impracticable during the foggy months.

At present only two master synoptic charts are drawn daily by the Weather Bureau, one at 8:00 A. M., E.S.T., and the other at 8:00 P. M., E.S.T. It would be extremely valuable to increase this number to four if possible, or to at least three. The latter could be accomplished without much additional expense, particularly if teletype communications are established. These additional maps might be drawn at 2:00 P. M., E.S.T. and 2:00 A. M., E.S.T. A 2:00 P. M. map would prove especially valuable and would probably be most convenient for the utilization of upper-air data. It is practically certain that the fourth map (2:00 A. M.) would eventually be found essential for satisfactory analyses. If not used immediately at 2:00 A. M. it could be used with the 8:00 A. M. map for the morning analysis of weather developments during the night. This practise is used in several of the best European meteorological institutes, where four to seven maps daily are found to be essential for detailed analyses. Consideration should be given to having the American maps synchronous with the European maps to provide a synoptic picture of the Northern Hemisphere in the general interest of future long-range forecasting.

For aviation forecasts, airways advices, etc., observations and reports are necessary every three hours or oftener over certain regions. This is a regional system, each region covering much less area than the general weather map area. Reports are collected and disseminated, each region for itself, allowing some overlap into contiguous regions.

If air-mass methods of analysis are to be undertaken more pertinent surface data must be made available and meteorological instruments at the various stations throughout the country should be given a more uniform exposure. Since urban exposures are rather unsatisfactory, due to radiation and turbulence effects, it is suggested that all instruments, the readings of which are to be used in the mapping, be placed at airports, since these are usually better situated for this purpose. At present the Weather Bureau has found it necessary to maintain a full staff at about fifty important airports in addition to the staff at the city offices. With removal of some of these instruments to airport sites this overlapping could be eliminated to some extent. Where present urban exposures are discontinued considerable change in existing climatological data might result. This condition could be remedied by retaining such urban exposures for a year or possibly longer in order to calculate a correction coefficient. Furthermore, the climatological value of urban exposures is doubtful, since the data are affected greatly by the growth of the cities.

The data now collected from Weather Bureau stations should be augmented to include the additional information required by the modern methods of analysis and forecasting. More frequent and more detailed ocean weather observations are highly desirable. The present telegraph code system will prove cumbersome for this purpose, and adoption of a modification of the International numerical code is recommended.

Aerological data should include: station, time of ascent, altitudes, temperature and humidity data at the ground and at each critical point. These data should be transmitted in a form which could be used without delay in the construction of a thermodynamical diagram which would present a picture of air-mass vertical structure. The evaluation of original data should be done at the aerological stations, thus eliminating similar elaborate calculations at all stations constructing synoptic charts. The metric system of units in the recording and transmission of all data is recommended in so far as it may be practicable.

(2) A modern weather service is impossible without a fast communication system by which frequent reports from a wide area may be collected, combined and redistributed for preparation of weather maps and forecasts by any system that is economical, rapid and efficient—by telegraph, telephone, teletype, radio or all these agencies combined. The teletype-writer now used by the Department of Commerce has proved extremely efficient both in speed and reliability and will need to be continued for the trunk-line services, but in so far as the meteorological service is concerned it should clearly be under the Weather Bureau. The combination of this service with the Weather Bureau's telegraph service would certainly eliminate much

present duplication and consequently reduce costs. The communications problem is intricate and an economical solution can be worked out, making use of all facilities, only under the direction of a single head.

In addition to the two major recommendations made above—recommendations which involve much cooperation between Government departments and very considerable reorganizations but little, if any, additional expenditures—the committee further recommends that the number of daily weather maps and general forecasts be immediately increased from the present number of two to at least three and very preferably to four. The Weather Bureau has already taken action looking to the allotment of $350,000 from the Public Works Fund to cover the expense of this proposed expanded service. This need has long been felt and urged.

The committee further recommends a certain decentralization of the general forecast work of the Weather Bureau by the establishment of more numerous district forecast centers in place of the five now existing, with the ultimate assignment of a trained meteorologist to each of the principal airports to collect weather observations hourly from the airway stations, to maintain a detailed corrected district weather map, and to offer to aviation and local industry a short-range weather forecast service for his district.

The committee further recommends that, although the air-mass analysis method unquestionably makes short range forecasts much more reliable, there should be an extension of climatological work which looks toward long-range forecasting. Contributing to this end is a calculation of climatological data by the various stations through the country that takes into account the frequency of occurrence of the various air-masses at all stations, inasmuch as they form a major component of the climate. Up to the present time statistical methods have formed the basis for such forecasts, and although high correlation coefficients have been obtained in some cases for short periods of time, they have proved unsatisfactory for forecasting purposes. New developments in air-mass theory and practise should be followed closely with a view to arriving at a better understanding of this very important problem.

An effort should be made to obtain the cooperation of other countries in the northern hemisphere, particularly Canada, Mexico and Russia (Siberia) in securing appropriate meteorological data which will disclose the movements of major air-mass over all these areas, in the interest of increasing the time range of weather forecasting.

The committee further recommends that the transition from our traditional system of weather forecasting to a new one using methods of frontal and air-mass analysis be made with caution in order that the present valuable service may not be jeopardized. Personnel with the requisite training are not at once available and must be trained gradually and the change made step by step. For example, it is suggested that one of the five present forecast centers be started on frontal analysis methods, under direction of the most competent man, trained in air-mass analysis, who may be available, and that forecasters be tested and apprenticed there before practising elsewhere. About five years might be devoted to the extension of the new method generally to perhaps seven additional stations, resulting in the eventual development of twelve separate forecast centers.

The committee further recommends that a system of "postgraduate" training for Weather Bureau meteorologists be inaugurated. It is certainly true that the personnel of the bureau who are to be given the responsibility of forecasting for all lines of industrial and commercial activity should receive thorough instruction in the more modern methods, and some plan should be devised whereby those men who already have a good basic training in meteorology, physics and mathematics and have shown some proficiency in the actual work of forecasting are detailed for a period of six months or a year to an institution of recognized leadership in this field, for such instruction. The expense of this instruction would not be large. Also, a system of "exchange" with meteorologists of outstanding foreign meteorological institutes should be worked out, and an effort made to maintain a strong technical staff at Washington and at a few of the leading field stations, in order to keep fully abreast of important developments in the field of meteorology and to conduct original investigations designed to increase the effectiveness of the service to all lines of industrial and commercial activity.

The committee further recommends that closer contact be maintained between directing officials at the Central Office in Washington, D. C., and the personnel at the various field stations throughout the country than at present obtains. The benefits from such contacts, in maintaining a high standard of morale and in developing a common understanding of the diverse needs to be served and of the problems to be attacked in serving those needs, will repay many-fold the comparatively small cost involved in travel.

The committee further recommends that a permanent Weather Bureau Committee, composed of four or five of the outstanding scientists of the country, be set up, the functions of which shall be to keep continually in touch with the work of the Weather Bureau, to be called into conference at least once a year, and oftener if need be, to advise on matters of weather service and policy, and to assist in presenting

the claims of the weather service both to the Government and to the public. Immediate questions which should engage the attention of this advisory committee would be: (1) The proper location and distribution of aerological stations; (2) the training of personnel; (3) the testing, selection and development of the most suitable aerological instruments; (4) research projects, particularly those looking toward the development of long-range forecasting methods.

ISAIAH BOWMAN
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WASHINGTON, D. C.
NOVEMBER 13, 1933

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLE PNEUMATIC PULSATOR

THE apparatus here described can be used with any type of laboratory apparatus in which it is desired to (1) move a fluid into and out of a vessel, or (2) to intermittently move a liquid in a given direction. Both types of fluid movement are used in the gas analysis apparatus at Davis[1] (the pneumatic pulsator has replaced the water-wheel pulsator formerly used).

Essentially, the pulsator has but one moving part. This is the valve mechanism, which is, in effect, two three-way stop-cocks so arranged as to operate simultaneously. This part of the apparatus is made of a steel-jacketed bronze bushing and snugly fitting shaft. The bushing is drilled with six holes, four of which are tapped and fitted with metal tubes. The shaft is drilled to correspond with the bushing, the holes having the same relative positions as those of the plugs of three-way stop-cocks. The bushing is stationary, while the shaft is movable, like the plug of a stop-cock. The construction of the valve mechanism is shown in the sketch.

To a metal arm fastened to the shaft are suspended two leveling bulbs, connected together by rubber tubing and partly filled with mercury. The arm A is prevented from rotating too far in either direction by rubber-cushioned metal bumpers (not shown in sketch), which are located just above the ends of the arm.

A metal weight is mounted at center of arm so that it shifts the center of gravity with each partial revolution of the arm, thus assisting in bringing the valve into correct position at the end of each partial revolution.

Suction is furnished by an ordinary filter pump attached to a water faucet. Both the pulsator and the filter pump are connected to a five-gallon bottle which is in turn connected by glass tubing to a second bottle twelve feet below, in such a way that an excess of suction pulls water up into the first bottle, whereas insufficient suction is compensated for by the pull of the water column which tends to run down into the lower bottle. The battery of bottles compensates for continuous small variations which occur in water pressure, and at the same time makes possible a smaller stream of water through the suction pump than would otherwise be required.

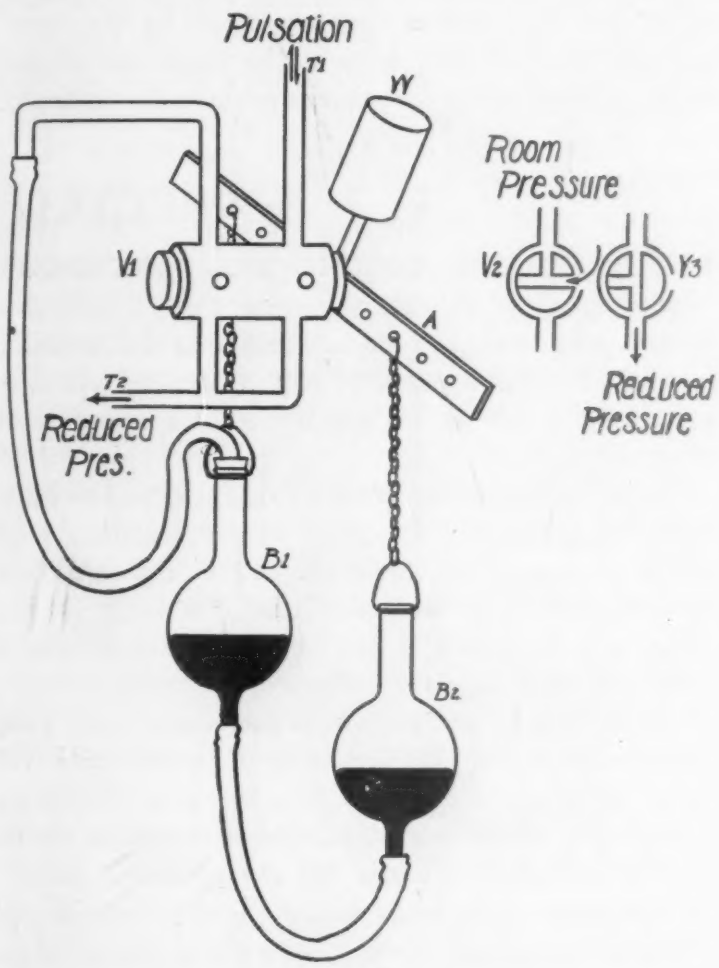

FIG. 1

EXPLANATION OF SKETCH

V_1 Projection of valve. Reduced pressure is drawing mercury into B_1 as shown in section of valve V_2

V_2 Cross-section of valve. B_2 is in its upper position. B_1 is open to room air and mercury is allowed to flow back into B_2

V_3 Cross-section of valve. B_2 is in its lower position and B_1 subjected to reduced pressure drawing mercury up into B_1

T_1 Tube carrying pulsations. Connection to be made here to tube leading to apparatus.

T_2 Reduced pressure connection.

W Weight mounted on moving arm to assist in bringing holes in shaft opposite holes in bearing.

A Arm fastened to shaft-supports leveling bulbs.

B_1 and B_2 Leveling bulbs.

[1] M. Kleiber, "Contribution to the Method of Gas Analysis for Respiration Trials," *Jour. Biol. Chem.*, 101: 3, p. 583, August, 1933.

The principle of operation is very simple. When at rest the unstoppered leveling bulb B_2 is in the lower position. When suction is turned on, mercury is pulled up into the stoppered bulb B_1 until the weight of this bulb becomes greater than that of the lower bulb. The upper bulb then descends, but does not reach a position as low as the highest position of the lower bulb. The partial rotation of the arm caused by the change in weights brings the valve to such a position that room air is free to flow into the stoppered bulb, and as a result of the increased pressure, mercury flows downward into the lower bulb. The shift in weight now pulls the lower bulb to its bottom position and changes the relative positions of the valve openings so that they are again in the same position in which they were at the beginning of the cycle. One set of valve openings actuates the pulsator itself, while the other produces changes in pressure in the tubing connected with whatever apparatus the pulsator is being used to run.

The pulsator can be easily and cheaply constructed, and most of the materials used are available in any laboratory. It is clean, quiet in operation, and can be placed anywhere out of the way. During the past few months the one now in use has been in operation almost daily and has required almost no care aside from weekly lubrications with vaseline.

The pulsator is adjustable through a wide range of speeds, ranging from very rapid to very slow pulsations. For use with the gas analysis apparatus the optimum speed has been found to be about four pulsations per minute.

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SPECIAL ARTICLES

EXPERIMENTAL TRICHINOSIS IN CHICKS

WHILE it is generally known that *Trichinella spiralis* will develop to the adult stage in the intestine of birds, the development of muscle larvae from oral infection, so far as we are aware, has never been observed.

In the present study mature Trichinella larvae have been demonstrated consistently in the musculature of chicks fed infective material. It is believed that failure heretofore to demonstrate this stage of the parasite in this host is due to the method of search employed (that of direct microscopic examination).

In the first of the present experiments, eight two-day-old chicks were fed thousands of isolated infective Trichinella larvae. On the first day after infection, one of the chicks was killed and a thorough search of the intestine was made for the parasite. A few young adults were found in the lower portion of the small intestine. Forty-five days after the infective feeding, two of the chicks died of a coccidial infection (diagnosed *Eimeria tenella* by Dr. E. Elizabeth Jones). A careful microscopic search of muscles failed to reveal any evidence of trichinosis. The white and dark meat were removed separately, then ground and treated by artificial peptic digestion. In the concentrated sediment from each, about two hundred fully developed Trichinella larvae were found, many of which were inactive and appeared lifeless. The remaining five chicks were killed a few days later. None showed infection by direct microscopic examination, but a few dead larvae were obtained from each chick by the digestion method.

It was thought that the lightness of the infections might be due to a mechanical destruction of a large number of larvae during their passage through the gizzard. To determine whether ingested larvae may thus be destroyed, a ten-week-old chick was fed thousands of isolated Trichinella larvae, and its droppings during the following three hours were collected for examination. In the intestinal discharges, numerous broken and mangled larvae were found, as well as many coiled larvae, which responded sluggishly to warmth. The chick was then killed and the entire intestinal tract examined. Active, uninjured larvae were found in the crop and proventriculus. In the gizzard and throughout the small and large intestine, however, many crushed forms and pieces of larvae were found along with others which were apparently unharmed. It is evident from these results that a large number of Trichinella larvae are destroyed in the gizzard of birds.

In the following experiments, it was hoped to establish a sufficiently heavy muscle infection whereby its nature could be studied. Four eleven-day-old chicks were etherized, and well over a thousand Trichinella larvae liberated from their cysts by the ingestion method were injected directly into the lumen of the jejunum of each. Three days later one of the chicks was killed. Numerous adult males and females with eggs in the uterus were found in the middle portion of the small intestine. The three remaining chicks were killed and examined fifty-four days after injection of larvae. Direct microscopic examinations of the muscles were negative. A few brownish dead larvae were obtained from each by the digestion method. From these results it is evident that the protective mechanism of chickens against trichinosis is not centered solely in the gizzard. According to

the observations of Ransom[1] and our own,[2] artificial digestion has no apparent injurious effect upon living trichinae. One may conclude, therefore, that most of the larvae are destroyed after dissemination in the body. The manner in which they are destroyed remains unknown, since, in no instance, have we been able to find the parasite *in situ*.

Feeding experiments were not undertaken with trichinous chick muscle because of the exceedingly light infections in all birds. It is likely that our method of examination is more reliable for demonstrating the presence of larvae than the feeding of muscle to experimental animals, for with the digestion method practically all the larvae, including degenerated ones, in a given amount of muscle are made apparent.

At no time did any of the chicks show discomfort or ill effects from the infections with Trichinella.

It may be concluded that Trichinella larvae occasionally invade and develop in the musculature of fowl. They have never occurred in sufficient numbers as to be microscopically demonstrable, so that their situation in relation to the muscle fiber is unknown. In this host the life of the larvae is evidently short, for a large proportion of those found appeared lifeless or degenerated. It is doubtful that infection from this source ever occurs.

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PRELIMINARY NOTE CONCERNING THE APPEARANCE OF EXPERIMENTAL DERMATITIS (PELLAGRA) IN RATS[1]

PELLAGRA, until comparatively recently, has been regarded as a food poisoning and attributed to the use of maize or Indian corn as a food.

After other theories were thought to have been the cause of pellagra, Goldberger in 1925 reported that there was concerned a heretofore unrecognized or unappreciated dietary factor which he designated as factor P–P, and which he believed played the essential rôle in the prevention of pellagra. His factor was later identified as vitamin B_2 or G.

Yeast, which is rich in this factor, proved effective in the treatment of pellagra cases and has become more or less routine treatment for the disease. However, this does not explain the high incidence of pellagra among people on maize or yellow corn.

Ethel Browning, in her monograph on the vitamin, says that "Mellanby's investigation (1930) into the toxic factors in cereals opens up a further interesting speculation, which may reconcile the conflicting results. He suggests that maize may contain a toxic factor which may be prevented from exercising its pellagra producing capacity by the presence of a protective factor of the nature of a vitamin, or possibly two vitamins—B_2 and A."

From a series of experiments carried on at Teachers College, Columbia University, it was suggested that this factor which Mellanby thinks caused toxicity might be B_1. These experiments showed that the pellagra producing capacity was not so much a question of low B_2 (G) as it was of low or subminimal amounts of B_2 (G) coupled with high or adequate B_1.

Animals were fed a B_1 and B_2 free diet. In one series the B_1 was normal, constant and the B_2 graded from subminimal to high, and in the second series the B_2 fed was normal, constant and the B_1 graded the same as above. It was found that when the B_2 was low or subminimal and B_1 adequate or high, pellagra developed more uniformly in practically all cases and with little variation in the number of days in the appearance of dermatitis.

These experiments would explain the appearance of pellagra on a diet of maize or any other of the whole cereals. They are rich in B_1 and low in B_2, and a continuous diet of such cereals supplemented with other foods containing little or no B_2 would produce pellagra if compatible with the theory.

A synthetic diet was used in the foregoing experiments. A series is now being run with an adequate diet, except that vitamin B_2 (G) has been destroyed by irradiation. Results are apparently comparable to the first series. Details of the experiment will be reported later.

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WALTER H. EDDY

CONTROL OF DOWNY MILDEW DISEASE OF TOBACCO THROUGH TEMPERATURE REGULATION

THE downy mildew or blue mold disease of tobacco caused by *Peronospora hyoscyami* DBy. has in the past two years become recognized as a very serious problem to tobacco growers in this country. This disease has long been destructive in Australia and no effective means of control are known. Among many suggestions made we find the possibility of temperature regulation mentioned and since the disease attacks the plants while they are still in the beds this would be a practicable measure.

In the Farmers' Handbook, 5th edition, published in 1929 by the New South Wales (Australia) Department of Agriculture, it is stated, "Experiments conducted by the department during the past few years indicate that if the temperature of the seedlings is not allowed to fall below 45 degrees F. and the surrounding air does not become humid, blue mold does not

[1] *Jour. Agric. Res.*, 5: 819, 1916.
[2] *Amer. Jour. Hyg.*, 17: 697, 1933.
[1] From the Laboratory of Physiological Chemistry, Teachers College, Columbia University, New York City.

make its appearance." This conclusion, however, was discredited by Angel,[1] who found that infection could be secured at temperatures as high as 31 degrees C., and he concludes, "It is, therefore, useless to attempt to control the disease by temperature modification only, as the plants are susceptible even at those temperatures that are much higher than the optimal for growth."

In our experimental approach to this problem it was recognized that at least three phases of the disease might be affected by temperature: (1) The production of conidia, (2) spore germination and infection, (3) subsequent development of the fungus in the host tissues.

In studying the influence of temperature on sporulation it was first established that this occurs in the early morning, and that this was not associated with light, since leaves held in complete darkness also sporulated about the same time. The conidiophores begin to grow out through the stomata on the under leaf surface just before dawn, and mature conidia can be gathered between 5 and 6 A. M. Sporulation, however, was not observed when the minimum temperature remained above 70° F., regardless of the maximum temperature, and in controlled temperature experiments good sporulation was only secured with temperatures ranging from 50 to 65° F., with a well defined optimum around 60–62° F. Furthermore, the temperature of the day previous was found to have an effect, and abundant sporulation was not secured with maximum day temperatures of 85° F. and above. Destructive outbreaks of the disease were invariably associated with periods of abundant sporulation.

Our studies of spore germination and infection yielded results comparable to those reported by Angel and indicated that infection was possible over a range of temperatures from 35 to 88° F.

Studies of disease development subsequent to infection, however, also yielded results of interest. With day temperatures rising above 85° F. and dropping to 70° or above at night, the fungus invaded only a small leaf area and quickly caused round, white lesions up to ¼ inch in diameter. These lesions made no further development and plants of fair size usually suffered no injury of consequence from such infections. However, when the day temperature did not go above 80° F. and the night temperature dropped to around 60° F., the fungus, following penetration, continued to spread through the leaf tissues, but without any destruction of tissues until about a week after inoculation. Then sporulation would occur over large portions of the leaf area, to be followed by the death of these parts. High temperatures consequently, while they do not inhibit infection, do prevent disease spread by preventing sporulation and also check the development of the fungus in the tissues of the host. The inhibiting effect of high temperatures has frequently been observed in the field, and periods of 5 or 6 days of hot weather have often so effectively checked the disease that it failed to renew its activity during a subsequent period of favorable weather conditions.

Proof of the practical efficiency of high temperature in controlling mildew has been obtained by the authors both in plant bed and greenhouse tests. In these experiments minimum temperatures of 70° F. or above were usually maintained, while high temperatures during the day were favored by the use of glass sash in place of cloth.

The temperature results have also solved the problem of how to keep the fungus in culture through the summer months, since it is an obligate parasite and can not be found in the field after warm weather begins. Plants growing in a chamber so constructed as to maintain a maximum and minimum of 80° and 60° F., however, have continued to provide all stages of the disease throughout the summer.

In conclusion it is to be pointed out that despite the effective disease control secured in our plant bed experiments this year it is not to be assumed that such satisfactory results would be secured under all conditions. The mildew, as it has occurred in this country during the past three years, has rarely caused severe damage until the latter part of the plant bed period, frequently at a time when the plants are almost large enough to set out. It is under these conditions that temperature regulation has proven most effective. On the other hand, our experiments indicate that small seedlings, if exposed to mildew attack, would not be so effectively protected, a fact that appears to be associated with the extreme susceptibility of the very young plants. Also our experiments have been conducted with flue-cured varieties, and there is one variety, White Burley, that is more susceptible to the mildew disease. It is probable that this increased susceptibility will make control of the disease more difficult with Burley.

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U. S. DEPARTMENT OF AGRICULTURE

[1] Australian Council for Scientific and Industrial Research, Bul. 65, 1932.

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SCIENCE NEWS

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THE CHICAGO MEETING

ALL patents and secret commercial processes must be foregone if the present industrial countries are to keep ahead of the Soviet Union in the race for the highest standard of living. This theory was advanced by Dr. A. P. M. Fleming, of the Metropolitan-Vickers Electrical Company of Manchester, England, at an engineering meeting of the American Association for the Advancement of Science. Since the social-economic problem of unemployment is world-wide except in the U. S. S. R., and the major portion of the blame can be laid to our modern scientific industrial system, Dr. Fleming believes that the solution lies in a removal of the barriers that impede the flow of all commercially useful information. The effects of applying science to industry and its bearing on unemployment are twofold. By improving the efficiency of industrial processes it reduces the necessity for manual labor, and conversely it creates new industries to reduce the number of unemployed. International pooling of scientific facilities are necessary to help to destroy this burden on all industrial centers. The U. S. S. R. contains within its boundaries most of the natural resources necessary for a very high standard of living. That country has organized its scientific activities under a central bureau, and expects science to play a leading rôle in its industrial and economic activities. "Whether the Soviet plans succeed or fail," Dr. Fleming said, "already enough has been accomplished to show the possibilities of this combined scientific effort. Even partial success may have far-reaching effects on the rest of the industrial world."

DEAN DEXTER S. KIMBALL, of the Cornell University College of Engineering, speaking before a joint meeting of several engineering and economic societies, pointed out that engineers of the future must also be students of economics if they expect to develop their fullest usefulness, and that if the engineer is to be an important figure in public affairs he must acquire a broader technique than that which he ordinarily possesses, and he must inform himself concerning a wide range of subjects of which ordinarily he knows little. Furthermore, he must acquire a wide knowledge of economic history and be able to trace the effect of economic changes over long periods of time. The broad economic problems that now trouble us are not isolated and circumscribed in character; most of them have long histories and many ramifications. It is true that some of the old economic theories developed in a handicraft age do not apply to our modern machine era, and the industrial engineers can do much to show their fallacious character. But on the whole the engineer who aspires to solve modern economic problems must expect to do an unusual amount of studying before he can replace these old theories with others that are suited to our day and methods.

PLANT cells resist the attack of fungi or other parasites by producing phenolic compounds, which are chemical relatives of carbolic acid. The invading threads of the parasite can break through these defenses of its victim, or "host," only if they do so before the surrounding cells have time to prepare their chemical warfare weapons. This secret of local immunity to parasitic attack in plants was explained by Dr. Jean Dufrénoy, of the Plant Pathology Station at Brive, France. Plants without resistance to parasite attack display two modes of behavior in their cells. Those of extremely susceptible plants apparently adopt a Pollyanna slogan of "business as usual," and do nothing about the invasion. The parasite simply makes itself at home, and spreads to other cells. Cells of plants still susceptible, but not on the extreme order, show a curious reversion to an infantile, or rather an embryonic, physiology. They cease to be able to form foods or to secrete other substances, and they convert into soluble form the food materials already present. This reversion to an embryonic condition is always signalled by the formation of many partitions of protoplasm, dividing the sap cavity or vacuole into many lobes or alcoves.

THE Wegener hypothesis, which holds that all the continents of the earth were once united in a single great land mass and subsequently drifted apart, received a hard blow at the hands of Professor Ludwig Diels, of the University of Berlin, who spoke before a meeting of the Botanical Society of America. Since Europe and North America are supposed by the theory to have lain edge to edge, back in the days of the dinosaurs, it would be reasonable to expect European and eastern American plants to be alike. But the only plants the two areas have in common are the ones that also grow all the way around the northern hemisphere. Distinctive things like magnolias and sorghum trees, that grow in the southeastern states, occur again not in Europe, but clear on the opposite side of the earth, in southeastern China. Other botanical reasons for doubting the Wegener hypothesis were also advanced by Professor Diels.

FROM the latest atom smashing comes proof that Einstein was right when, years before he introduced relativity, he formulated the law that mass and energy are interchangeable. Using the world's largest mass spectroscope, a kind of atom analyzer, Dr. K. T. Bainbridge, of the Bartol Research Foundation of the Franklin Institute, weighed with extreme accuracy the newly discovered heavy-weight hydrogen and the two varieties of lithium atoms. The atoms weigh only about one millionth of one millionth of one millionth of one millionth of an ounce and Dr. Bainbridge's mass-measuring spectroscope with its two-ton magnet weighs them to an accuracy of one part in ten to thirty thousand. He used these weights in computations based on atomic disintegration experiments made during the past year at the Cambridge Cavendish Laboratory, at the University of California and at Paris. Dr. J. D. Cockcroft, present at the meeting, was de-

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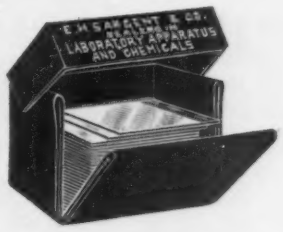

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lighted to learn that the atom rearranging he did with Dr. E. T. S. Walton in Cavendish Laboratory last year upholds the Einstein law. Hydrogen hearts of protons were hurled at atoms of lithium isotope seven, and two alpha particles, or helium nuclei, flew off. Dr. Bainbridge's figures show that the mass lost was transformed into energy as the Einstein law requires. Similarly, Dr. Bainbridge showed that the California experiments of Drs. G. N. Lewis, M. S. Livingston and E. O. Lawrence, in which lithium was bombarded with heavy hydrogen, and the Paris experiments of Dr. Irene Curie and Dr. G. Joliot, in which lithium was bombarded with helium, also satisfied the Einstein theoretical relation of mass and energy. Dr. Bainbridge concluded that the new weighing of the neutron shows that it is slightly lighter than the light hydrogen atom. Its weight is 1.0065 while hydrogen's weight is 1.0078.

CHEMISTRY'S 93 elements are still but ninety-three in number, but many of them have developed what a biologist would call subspecies or varieties as a result of recent research. That is, a given element that used to have only one atomic weight assigned to it now proves to be a mixture of atoms of several different atomic weights, usually fairly close together. Such elemental varieties the chemist calls isotopes. Professor Fred Allison, of the Alabama Polytechnic Institute, spoke of his use of a method of his own invention, the magneto-optic method, for detecting isotopes when they are present in exceedingly minute proportions. The magneto-optic method consists essentially in shooting a ray of light through a solution of the material to be tested, and then suddenly slamming on a powerful magnetic field. The light, which is in the state known as polarized, is rotated more or less, according to the composition of the solution under examination. Using this method, Professor Allison has discovered that the light metal beryllium, which may some day become as familiar as common aluminum, is made up of two isotopes. Mercury is shown to have twelve isotopes, three of them hitherto undetected by previously used chemical methods. And there are no less than fourteen isotopes of zinc.

EARTH-MATERIALS under extremely high pressures, such as they have to endure at considerable depths in the earth's interior, act structurally much as they would if subjected to high temperatures. This is one of the results of x-ray investigations of matter at high pressures reported by Dr. Willi M. Cohn, of Berkeley, California, before the meeting of the American Physical Society. In a special apparatus, it has been made possible to attain pressures as high as 3,000 atmospheres, or 45,000 pounds per square inch. Of course, to obtain such pressure it is necessary to make the metal walls of the cylinder thick and exceedingly strong. This would of necessity interpose a very difficult barrier to the passage of x-rays by means of which the materials under pressure are to be studied. This difficulty is avoided by setting a window of beryllium, a very light but very strong metal, on the side where the rays are admitted. Opposite this window, on the "exit" side, is a second window of glass or bakelite. Behind this the photographic plate is placed. Photographs of the minute structure of the materials under study, made with x-rays both before and after the pressure is applied, give patterns from which it is possible to deduce the physical changes taking place.

VARIABLE stars, which shine brightly for a given period and then become dimmer for a time, have a second and invisible variability, at least in certain types of such stars, according to Dr. Edison Pettit and Dr. Seth B. Nicholson, of the Mount Wilson Observatory of the Carnegie Institution of Washington. They have trained exceedingly sensitive instruments, attached to telescopes, on a number of variable stars of one special type. Although such stars get hotter as they grow brighter, and cooler as they grow dimmer, nevertheless when the total amount of radiation, visible and invisible, is measured, the time of maximum radiation is found to lag appreciably behind the time of maximum brightness.

How the old trick of bending a wire or a piece of tin back and forth until it finally breaks is used scientifically to test the strength of steel and other metals was described before the meeting of the American Society for Testing Materials. Professor H. F. Moore and H. B. Wishart, of the University of Illinois, told of a new method for determining the endurance limit of samples of rail steel and similar metals. Short strips of the metal are placed in a machine that will bend them back and forth 1,500 times a minute. The machine is left running all night, so that by morning the samples have been put through 1,400,000 cycles of bending. In the morning the samples are taken out and put in other machines that pull them until they break, at the same time measuring the tension necessary to pull them in two. Really good metals often have their tensile strength actually increased by the long siege of bending back and forth. But hidden flaws or faults in the metal will start cracks, and the sample will either be found broken at the end of its back-and-forth bending ordeal, or will pull in two relatively easily in the tension machine.

AT the same meeting, R. L. Templin, research engineer of New Kensington, Pennsylvania, told of similar testing machines that have been devised for studying "fatigue" in aluminum and light-metal alloys. These require a great deal more of the back-and-forth bending than do steel samples: 500,000,000 cycles of it are necessary for most of the light alloys. Another endurance test described by Mr. Templin is performed on light-metal wires and cables such as are used in aircraft construction. Long samples of these are placed under known tension and "wobbled" up and down by electrically driven machinery until they break. An automatic registering device counts the number of vibrations, and stops when the specimen at last gives way.

CADMIUM, a metal now well known only to chemists and metallurgists, may join chromium, tungsten and aluminum in the procession of metals that have marched out of the scientific laboratory into the rank-and-file familiarity of daily common use. C. E. Swartz and A. J. Phillips, of the American Smelting and Refining Company, Maurer, New Jersey, told of their researches on

babbit metals for engine and other machine bearings that must work at high temperatures. They found that by substituting cadmium for tin as a base in such metals they could build bearings that will operate satisfactorily at temperatures up to 570 degrees Fahrenheit. These bearings were not brittle, and they were soft enough so that they would not scratch the mildest of steel shafts.

To avoid leaky walls, use absorbent, "soaky" brick and make the mortar joints thin. These recommendations were made by Professor W. C. Voss, of the Massachusetts Institute of Technology. The brick should be able to absorb from 5 to 10 per cent. of its weight in water in two days; and most of this absorption should take place in the first ten minutes of soaking. The bricks' ability to "drink water" insures good bonding with the mortar, making the wall into practically one solid piece. There should be some lime in the mortar to insure this action, Professor Voss recommended. Brick structures are commonly thought of as being stiff and unyielding, and likely to crack suddenly under heavy loads. Yet brick masonry beams built and tested under the supervision of Professor M. O. Whitney, of the University of Wisconsin, showed astonishing degrees of flexibility. The bricks are laid in a mortar containing a high proportion of Portland cement, on various types of steel framework, which served as reinforcement after the masonry beams had solidified.

YELLOWSTONE PARK hot springs deposit travertine, a limestone-like substance, containing minute quantities of radium. The amount in a given deposit varies according to its age. Professor Herman Schlundt, of the University of Missouri, told of studies that have enabled him to estimate the ages of some of the hot springs formations at Mammoth Hot Springs, the park headquarters. Minerva Terrace, Hymen Terrace and Pulpit Terrace, now active, are very young—not much over one hundred years. Liberty Cap, the cone of an extinct hot spring, is about 2,500 years old. Hotel Terrace, a long-extinct hot springs area, is estimated to be about 3,200 years of age. Behind all the present and recent hot springs formations rises Terrace Mountain, which has ancient extinct hot springs at its top; these springs are estimated to be more than 14,000 years old.

WITH a thermometer in the depths of a Wisconsin copper mine as their "calendar of prehistory," two geologists have estimated that the last ice age withdrew from northern Wisconsin twenty to thirty thousand years ago. The scientists, Drs. W. O. Hotchkiss, president of Michigan College of Mining and Technology, and L. R. Ingersoll, of the University of Wisconsin, told how they obtained their data and made calculations. The new figure is much less than the estimated period since the Niagara Falls region was free of a continental glacier. It is greater than the seven or eight thousand years European geologists have determined from studies of layers of sediment as the time since the retreat of the last ice sheet from parts of Norway and Sweden. But it does agree roughly, as geological time is approximated, with the dates set for the retreat of the last great ice shelf from Europe and North America. The temperature measurements, which were made at levels 500 feet apart to a depth of one mile, also indicate that the melting of the ice "was followed, perhaps after several thousand years, by a period distinctly warmer than the present, which was succeeded in turn by one slightly cooler and lasting until rather recent times." Only the average temperature of the ground varied in this manner, it was pointed out, while the average air temperature could have been different. The calculations depend on the assumption, which geologists consider reasonable, that the last ice sheet covered the site of the measurements for about 50,000 years. In this time it would have cooled the ground to the same temperature throughout the mile depth in which measurements were taken.

PLANTS could use more of the light the sun sheds on them if they had more carbon dioxide to work on. They are in the position of factories with plenty of power available but not enough of raw material. Mr. Hoover and his colleagues in Washington have been shining light of various colors and known levels of energy on wheat plants, giving them various concentrations of carbon dioxide in the air supply, and measuring the rates at which they use it up. They found that wheat plants use red and yellow light with about equal efficiency, violet light with much less—only about thirty per cent. of the red. They found also that plants would use as much carbon dioxide as they could get, making it over into food and plant tissues. At the same session, Professor Ernest Shaw Reynolds, of the Missouri Botanic Garden, St. Louis, told of the effects of radiation on growth. Plants are not "just plants," he warned, and the results you get from a given experiment on a wheat plant can not necessarily be assumed to be true for a bean. Nor can it be assumed that because a plant responds in a certain way to light or other stimuli while it is young, it will respond in the same way when it is older.

ELECTRICAL instruments so delicate that they will register a millionth of a volt are being used to explore microscopic areas of the brain, according to Professor C. Judson Herrick, of the University of Chicago. Information thus obtained is expected to revolutionize our whole knowledge of the way the human mechanism works. Professor Herrick ventured the prediction that "the electro-biological era now beginning will yield as revolutionary changes in our conceptions of the physiology of the nervous system as the invention of the microscope inaugurated in anatomy." There are from ten to fourteen billion nerve cells in the cerebral cortex—the part of the brain with which we think—and they are arranged in definite patterns. It is the little electric currents that flow from cell to cell and from group to group that the new electrical methods are measuring. This new knowledge of inter-cell telegraphy in the brain promises to yield positive results in understanding differences in behavior between man and his evolutionary cousins, the higher apes, and among the human races themselves, that the older methods, which depended on the study of the grosser features of the brain, could only block out roughly.

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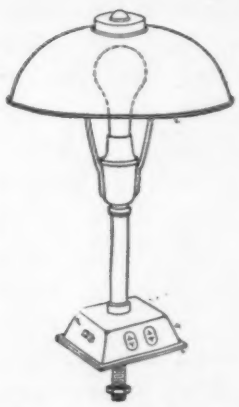

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MEASUREMENTS OF A STAR'S MAGNITUDE

THE strange companion of Sirius, the dog-star, which is so dense that a cubic inch of the stuff of which it is made would weigh 25 tons if a piece could be transported to the earth's surface, is about three times as bright as astronomers have previously supposed.

Dr. A. N. Vyssotsky, of the Leander McCormick Observatory of the University of Virginia, has recently completed a new determination of the brightness of this remarkable little star. A full account of his researches will appear in the forthcoming issue of *The Astrophysical Journal.*

Though Sirius B, as the companion is called, is not very much fainter than stars that can be seen with the naked eye, it is very difficult to observe because of its proximity to Sirius, brightest of all the stars in the sky. Even with telescopes powerful enough to reveal it easily, measurements of its brightness are complicated by Sirius' overpowering glare.

The new method employed by Dr. Vyssotsky makes use of the fact that when a grating of fine parallel wires is placed over the lens of a telescope, and a star photograph taken, the image of the star is accompanied on either side by a series of images of its spectrum. The closer the wires, the more spread out are the spectral images.

Dr. Vyssotsky placed such a grating over the 26-inch lens of the McCormick Observatory's telescope and photographed Sirius and the companion. The arrangement of the wires was chosen so that the first spectral images were just as far from Sirius as the companion's image. On the resulting plate appears the main star image, spread out into a small disk because of the star's brilliance. On either side are the images of the spectrum, looking very much like the image of the companion, just below.

The brightness of such a spectrum image, in relation to the star itself, can be calculated, and thus Dr. Vyssotsky found how bright the images should appear. But they, like the image of Sirius B, are affected by proximity to the bright star. In this way he found how much of an effect the glare of Sirius produced, and when this correction was applied to the measured brightness of the image of the companion, he found its magnitude to be 7.25, instead of 8.44, which has previously been accepted.

This determination was checked in another way, by making double exposures, in the same way that a movie camera man can photograph an actor talking to himself. The plate was first exposed on a very bright star, and then exposed again on a cluster of faint stars, one of which came close to the bright one, and thus played the part of the companion. The brightness of the faint star was then determined separately, and the effect of the glare measured. This method gave a value for the magnitude of Sirius B as 6.91. The mean of the two determinations is 7.1, which Dr. Vyssotsky adopts as the best value for the brightness of Sirius B. With the naked eye, under good conditions, stars as faint as the sixth magnitude can be seen.

PHOTOCELL TO MEASURE THE SMOOTHNESS OF POLISHED METALS

DETERMINATIONS of the degree of smoothness of polished metals have recently been made by the French metallurgist, Dr. Albert Portevin, through the application of the photoelectric cell.

A beam of light is focused on the metal specimen so that it will be reflected to the sensitive cell. When the specimen is moved along in the path of the beam, any microscopic hills or valleys will register as fluctuations in the electric current produced by the cell due to the variations in intensity of the reflected light.

Extensive use is made of smoothness determinations in the examination of machine parts subject to frictional wear. They are valuable for indicating the relative efficiency of different abrasives employed in polishing metals. They are of great assistance in work in certain specialized fields.

Although numerous methods have been developed for studying the quality of polish, this latest adaptation of the ever popular photoelectric cell to the problem promises to supersede some of the laboratory methods now in vogue. This is particularly true in the case of the study of the surfaces of metals intended for corrosion tests. Here the initial degree of smoothness is of vital importance to the interpretation of the results of such tests.

Metals which have become colored during the process of corrosion, or upon heating as in the case of tempered steel, have to be examined with light consisting of only one wave-length (color) and a colored filter must be placed in the path of the reflected ray to insure accuracy of results. If white light were used, the result would be unsatisfactory due to the presence of many different wave-lengths.

A DISEASE RESISTANT BANANA

VICTORY over the dreaded Panama disease which has cost banana growers millions of dollars in the last few years appears to be within measurable sight of achievement, according to experiments carried out by Professor E. E. Cheesman, of the Imperial College of Tropical Agriculture, Trinidad.

Professor Cheesman believes he has created a fruit which is completely immune to Panama disease and at the present time samples are being sent out to growers for further and more complete tests. Known as 1.C.2, the new variety has been planted alongside trees severely stricken with Panama disease, yet no sign of the disease has been found.

In March, 1925, a variety known as 1.C.1 was evolved and this plant has proved to be completely resistant to Panama disease following continual close investigation ever since, but it has the grave commercial disadvantage that an occasional seed is noted as a result of self-

pollination when multiplied by suckers and grown under ordinary banana field conditions.

The primary economic end kept in view throughout the investigation has been the production of a new variety of banana combining resistance to Panama disease with the good commercial qualities of Gros Michel, the outstanding variety of northern markets.

Experiments carried out so far by Professor Cheesman have shown that the new variety, 1.C.2, is completely seedless, while it is hoped to produce fruit of a good size. Furthermore, it is hoped that it will have the other necessary required commercial qualities such as compactness of bunch, a fruit skin not abnormally sensitive to bruising, ability to stand up well to conditions of bulk transport, and an attractive appearance on ripening.

In regard to the seed aspect of the problem the difficulty is scientifically extremely complex for bananas are naturally reproduced by vegetative means. The plant breeder must first induce the formation of seeds and then, if he wishes, he must completely eliminate them again. A banana seed, which the great majority of banana-eaters in temperate countries have never seen, is about a quarter of an inch in diameter, black in color, and very hard. Naturally, the presence of these seeds in the fruit would not enhance its market value.

In attaining his present success, Professor Cheesman has had to explore the whole genetics of bananas and the breeding work has necessitated the introduction and study of a wide range of varieties. The Imperial College collection contains about one hundred "numbers" obtained from several parts of the Tropics. Tests have been made with all these during the effort to produce a specimen immune to Panama disease.

A Londoner by birth, Professor Cheesman has been engaged in his research work at the Imperial College for the past ten years.

A TWELVE-LEGGED SEA SPIDER

A SEA spider with six pairs of legs, instead of the customary four pairs, was captured by Sir Douglas Mawson in the Antarctic during the British, Australian and New Zealand Expedition. It was found at a depth of two hundred fathoms.

The discovery was announced at a meeting of the Royal Society by Dr. W. T. Calman, keeper of Zoology at the British Museum, who is in charge of the work of examining Sir Douglas Mawson's specimens.

Dodecolopoda mawsoni, as the new species of animal is named, was exhibited at the Royal Society. The interest aroused among biologists is gauged by the fact that there are some 400 known species of marine arthropidae, or insects, with the standard four pairs of legs, corresponding to the three pairs of legs of land insects. The only previous exceptions to this apparent law of nature had five pairs of legs. The first of the ten-legged "freaks" was found off South Georgia by the American scientist, Eights, approximately a century ago. Though a few others have since been found the existence of twelve-legged pycnogonidae had not been suspected.

Dr. E. W. MacBride, professor of zoology at the Imperial College of Science, suggested that the extra number of legs "may have been added as an afterthought," in the same kind of way as the North American starfish, which originally had five rays and still drops from its larva in five-rayed form, now has further rays that grow in between the primary five.

Both the ten-legged and twelve-legged arthropidae have been found in the Antarctic zone, suggesting that this environment may call for additional legs, possibly to facilitate food capture.

ELECTRICAL DEVICE FOR MEASURING "M" RAYS

ELECTRICAL measurement of the so-called "M" rays or Gurwitsch rays, given off by living cells, has been accomplished by Dr. Boris Rajewsky, docent of the Institute for the Physical Foundation of Medicine at Frankfurt-am-Main. Biologists and physicists have long been trying to construct a device that would give a physical measurement of these mysterious radiations, but until now without success, and they have had perforce to continue measuring them by the old way of exposing other living cells to their action.

The Rajewsky apparatus is based on the principle of the Geiger counter, which is a device for detecting traveling electrons and other charged particles by letting them hit a wire and thus give an electrical "kick," amplified to detectable magnitude by a radio-like hookup.

However, Dr. Rajewsky built several important modifications into his apparatus. Into the side of the tube through which the radiations were to be directed he set a quartz window, for the Gurwitsch rays are stopped by glass though they pass through quartz. The wire he covered with a semi-conducting material, to make it somewhat less sensitive. And between wire and window he installed a thin sheet of cadmium.

Cadmium is sensitive to rays of 3,000 Angstrom unit wave-length, which is the approximate amplitude of the Gurwitsch rays. Whenever rays of this length fall on the metal, they release electrons, which in their turn electrically charge the air between the cadmium and the wire. Thus the cadmium becomes the means for the indirect expression of the Gurwitsch rays in electrical terms, and enables the experimenter to obtain a quantitative idea of their energy.

RATE OF SAP FLOW IN PLANTS

How to determine the rate that sap rises in trees and smaller plants has always been a difficult problem. And it is of great practical importance, too, in all applications of the science, from forestry to farming under irrigation. All methods hitherto in use have involved injuring the plant in some way, by boring holes or injecting foreign substances, and to that extent inrtoducing unnatural conditions with the risk of falsifying the result.

But now Professor Bruno Huber, of the Darmstadt Technical University, has devised a way to measure the speed of the transpiration stream in plants without injuring them. He wraps a wire around the stem and heats it electrically for several seconds, which causes the temperature of the sap to rise by fractions of a degree. A few inches higher up the passage of the heated sap

is registered by a tiny electrical thermometer which can be introduced between bark and wood without doing any harm. This method, of course, is efficient only if the sap flows more quickly than it loses its heat, which is the case when the speed is more than half an inch a minute.

In this way it is easy to observe the daily speed fluctuations in one and the same plant throughout the year. For instance, Professor Huber found that the sap in a vine moved with a speed of 30 inches an hour between 6 and 7 o'clock in the morning, that at 1 o'clock the speed rose to approximately 28 feet an hour and fell again to about 30 inches an hour at night.

In the case of conifers, the condition that the sap should move more quickly than it loses its heat is not fulfilled, so that measurements are impossible. But in the case of foliage trees he found speeds from the measurable minimum up to 36 feet per hour, with vines even up to 150 feet per hour.

THE CEPHALIC-MEDULAR ANGLE

THE height of a man's brow is no indication of his intelligence, but the angle at which his brain is attached to its stalk may be. Studies indicating that this cranial angle may prove a good method of rating intelligence have just been completed by Dr. Salvador Pérez Alvarez, of the Medical School of the Mexican National University.

Low in the zoological scale the angle between the brain and the stalk from the spinal column is almost a line, or in other words an angle of 180 degrees. The angle, called the cephalic-medular angle of the cranium, bends more and more closely in the higher animals until in man it is almost a 90 degree angle.

This fact suggested to Dr. Pérez a relationship between cerebral development and the size of the angle. He thought that the angle might be an index of mental development in individual human beings as it is in the zoological scale.

He therefore made measurements on 400 persons equally divided between children, adolescents, youths and adults. He found that in these 400 cases the angle varied between 93 and 104 degrees, and that sex was no factor in this variation. The angle reached its final value between the ages of ten and thirteen. Dr. Pérez applied regular mental tests to these same individuals, and found that those rating the highest in the tests had the smallest angles. Taking the four groups separately, there was improvement in mental ratings due to age. Experimentation is being continued to see how well this new method may be applied in place of the ordinary and complicated intelligence tests.

In a general demographic study to be begun in Mexico in September of this year under the direction of Dr. Manuel Gamio, the well-known Mexican anthropologist, Dr. Pérez will try his method on groups of Indians, mestizos and whites in order to see if this cephalic-medular angle is a racial characteristic as well. An instrument has been developed by Dr. Pérez to measure this angle in man.

ITEMS

RADIATIONS like x-rays or the gamma-rays from radium that destroy harmful growths in the body, or sometimes do injury to normal tissues, accomplish their often revolutionary work with very small amounts of actual energy expenditure, according to Professor Friedrich Dessauer, of Frankfurt-am-Main. A spoonful of hot tea brings more energy into the body in the form of heat than all the radiation reaching the inner tissues in a carcinoma treatment. From this fact Professor Dessauer infers that the work of such radiation is done practically at the instant of first impact, while they are still concentrated and before they have had opportunity to become dispersed into neighboring regions. Assuming that the primary result of any radiation is regularly to set free an electron somewhere, Professor Dessauer concludes that such an electron discharged from an atom and roaming around within a protein molecule should be expected to cause inner vibrations in it. This condition may be described by stating that the one individual molecule hit by the radiation has been raised to a higher temperature. Therefore, Professor Dessauer speaks of "point heat" as the actual cause of the devastating effects of radiation.

A NAME is wanted for the newest particle discovered by science, the positive electron. "Positron" has been suggested and is widely accepted. But many object to it, on the grounds that it lacks proper character. Professor Niels Bohr in his talks to the California Institute of Technology, where the positive electron was discovered, pointed out the desirability of a new name and mentioned "anti-electron" as a possibility but did not urge it. He said it had the advantage that it suggested the fact that the positive electron is, in a sense, merely the absence of the negative electron. The most brilliant suggestion, however, has come from Professor Herbert Dingle, of the Imperial College of Science and Technology in South Kensington, visiting in Pasadena. He recalled the fact that Electra had a brother Orestes and surely the positive and negative electrons are like brother and sister. He therefore suggested the name "Oreston" for the positive electron.

PLANTS given several light doses of x-rays in the laboratory of Professor Charles A. Shull, of the University of Chicago, proved more resistant to a "killing" dose of thirty minutes' duration than did similar plants which were not given the preparatory treatment. This was one of the experiments reported before the meeting of the American Society of Plant Physiologists. He cautioned against too-hasty generalizations on the basis of this one experiment, but suggested that if further tests confirm the possibility of self-immunization by x-rays the consequences may be very important biologically. In other experiments it was shown that x-raying wheat plants, under proper screening, resulted in more vigorous growth, larger production of plant tissue, and a considerable speeding up of the life cycle. The stalks always headed out earlier in rayed than in unrayed wheat plants.

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SCIENCE NEWS

Science Service, Washington, D. C.

THE FELS PLANETARIUM

ON a sheet metal dome, 65 feet in diameter and perforated with millions of small holes, it will soon be possible to see reproduced the starry skies as they appear from any part of the earth at any time.

America's second optical planetarium opens about the middle of October as part of the Benjamin Franklin Memorial and the Franklin Institute, whose $4,000,000 building is nearing completion at a location close to the city's center. The planetarium, made by the Carl Zeiss optical works in Jena, Germany, is the donation of Samuel S. Fels. It will be known as the Fels Planetarium. The building will house also a technical museum similar in scope to the famous Deutsches Museum in Munich. The museum will open at a later date, probably in December.

Eighteen planetaria are now in operation in European cities. The Adler Planetarium, opened in Chicago three years ago, was the first in the United States. Planetaria have also been assured for Los Angeles and New York.

The projection device, the part of the apparatus imported from Germany, is a glorified stereopticon, and stands in the center of the hemispherical dome. Through 119 separate lenses, images of all the naked-eye stars and planets, as well as the sun and moon, are projected on the dome's white inner surface, where they are seen by the audience, seated below around the instrument. The entire machine is controlled by the lecturer through a complicated switchboard. A number of motors cause the various objects to move in their proper orbits, but at greatly accelerated speeds. It is also possible to show the sky of the southern hemisphere, picturing stars which never can be seen from the United States.

The Fels Planetarium will be the first to have a truly hemispherical dome. Previous planetaria projection surfaces were made of stretched cloth, forming a series of flat figures. In Chicago's Adler Planetarium the cloth is stretched from a series of wooden rings, so that the dome consists of zones, one above another, and each forming the frustum of a cone. The Philadelphia dome is made of sheets of stainless steel, each one formed to the proper curvature before erection. Each sheet is welded to its neighbors.

As a solid metal dome would produce objectionable echoes, the steel sheets are perforated with millions of holes, one sixteenth of an inch in diameter, and an eighth of an inch apart. Tests made by acoustic experts have shown that sound passes through such perforated metal as readily as through stretched cloth. The walls behind the dome are covered with sound-absorbing pads, so that the voice of the lecturer will not be reflected, and the effect will be the same as if he were speaking on an open plain at night. With most of the other planetaria echoes are avoided by a series of steel baffle plates hung behind the cloth dome. These reflect the sound in many directions, but do not absorb it. To keep the dome clean and the audience comfortable, all air supplied to the chamber will be cleaned and conditioned.

The astronomical section of the Franklin Institute Museum will include a public observatory, with two large telescopes, a reflector with a mirror 24 inches in diameter and a refractor with a lens 10 inches in diameter, as well as numerous models, astronomical photographs shown as transparencies, and historic instruments.

RESTORATION OF A HORNED DINOSAUR AT YALE UNIVERSITY

BEAKED like a tortoise, horned like a rhinoceros, its muscles and skin skillfully restored by anatomists, a twenty-foot dinosaur has just been placed on exhibition in the Peabody Museum of Natural History at Yale University. The monster is of the genus known to paleontologists as Monoclonius, and it lived a hundred million years ago, more or less, in the Cretaceous age.

The skeleton around which the restoration has been built was collected in the Red Deer region of Alberta, Canada, by Barnum Brown, of the American Museum of Natural History, and was purchased by the Peabody Museum. Almost all the bones were recovered.

When the skeleton was assembled at the Peabody Museum it was placed in a walking posture, its feet set to match certain three-toed dinosaur tracks on slabs of rock in the region where it was found; these tracks may possibly have been made by the same or a similar species.

The restoration of flesh and skin was undertaken for one side only, leaving the bony framework visible from the other side. The mount thus gives a graphic illustration of how scientists reconstruct the probable living appearance of a long-extinct animal.

Each muscle was modeled separately in plasteline, thus building up the entire contour of the head, body, limbs and tail. Part of a Monoclonius skin has been recovered, and is now in the American Museum of Natural History. Using this as a pattern, a mould was prepared, showing the studding of small bony plates that apparently gave the creature a partial armoring. Into this the plastic materials for the skin were pressed. After the restored skin was mounted on the specimen, the whole creature was painted a sort of general "reptile color," following the hues of animals of that class living to-day, but without imitating any particular one of them.

Monoclonius, in spite of his formidable appearance, was a vegetarian and probably not at all fierce. The wide frill that projected from the edge of his skull over the back of his neck afforded that vital region some protection, and possibly his forward-projecting horn could be used as a defensive weapon. There were four additional horn-like appendages to the bony skull-frill, whose usefulness, if any, has not been determined.

THE STRATOSPHERE ASCENT FROM CHICAGO

WHEN the stratosphere balloon takes off sometime this month for its flight into the unknown upper reaches of

the atmosphere, no one will know just where it will come down.

The balloon will take off in conventional fashion from the grounds of the Century of Progress Exposition, but it may come down in one of the Great Lakes, in some cotton field of Tennessee, or even in the Atlantic Ocean. Lieutenant-commander T. G. W. Settle, U. S. N., the pilot who will take the craft up in an attempt to reach a record altitude, will be able to predict at the time of his ascent the general direction in which his descent will be made, and he expects to land within 300 miles of Chicago if all conditions are favorable, but more than that no one can know.

The steering of a balloon is quite a different matter from the guiding of an airplane or dirigible. The balloon must travel wherever the currents of air carry it. When balloons are taking part in a race and attempting to reach a particular destination in the shortest possible time, the pilot watches the winds very carefully. Usually the direction and speed of the wind differs greatly at different altitudes, so that by selecting carefully the altitude at which he travels he can have some control over both direction and speed of the balloon. In case the winds for a time are unfavorable at all practical altitudes, he would select that layer having the lowest wind velocity, so that at least he would not be losing ground too fast.

But in the stratosphere ascent, the problem is quite different from that of the racer. The destination and speed are unimportant. The only purpose is to go up as far as man can go. All sorts of winds may be encountered before the ceiling is reached.

Lieutenant-commander Settle plans, however, to wait for wind currents which are mainly in a southeast direction with a low velocity. It is probable, therefore, that he will come down somewhere southeast of Chicago, and not too far away. The balloon is prepared to land on either land or water.

He will also wait for favorable weather conditions, so that there will be a minimum of danger from downward vertical currents or striking by lightning. He will also wait until there is no rain to freeze on the gondola and thus add weight to the craft. The condensing of moisture on the outside of the ship is not anticipated because no attempt to go up will be made when the air at lower altitudes is not clear. The moisture in the very high cirrus clouds, those wispy, "mare's tails" which are seen on clear days, is already frozen in hard ice particles, and will bounce off the surface of the ship's sphere, leaving it free. So far as the depositing of moisture on the interior surface and its consequent freezing is concerned, apparatus carried is expected to keep the humidity below the precipitation point.

METHYLENE BLUE AND CYANIDE POISONING

METHYLENE blue as an antidote for cyanide or carbon monoxide poisoning is now the subject of a heated controversy.

The blue dye received its first trial as a poison antidote in California. Several cases in which the treatment has been successful have been reported from San Francisco and elsewhere. Its use became routine in the Emergency Hospitals of the San Francisco Health Department for cases in which the patients were brought in apparently dying from the effects of one or the other of these two deadly poisons.

Strenuous objection to this use of the dye has been brought forward by other investigators within the last few months. Statements were made that the blue dye, instead of saving lives of carbon monoxide victims, might actually hasten death and that its use was at least decidedly limited in cases of cyanide poisoning. Experiments supporting these statements have been reported in scientific literature, as well as experiments supporting the value of the dye as an antidote for cyanide and carbon monoxide.

For a time the use of the dye was suspended by the Emergency Hospitals Service of the San Francisco Health Department. As a result of further consultation and clinical experience, however, the treatment has been resumed. In carbon monoxide poisoning the dye is used in addition to the standard methods of treating this condition. No deaths from the use of the dye in treating the two types of poison cases appear to have been reported, while there have been several instances in which lives have been saved.

The methylene blue treatment was the subject of a minor controversy earlier in its history. This centered over whether or not proper recognition had been given the first use in animals and for the first suggestion of its use in man in such poisoning cases.

STANDARDIZATION OF ERGOT

THE official standards for ergot and fluid extract of ergot, a drug once widely used in childbirth, have been revised. The new standards and methods of testing the drug have been announced by Dr. E. Fullerton Cook, of Philadelphia, chairman of the Committee of Revision of the U. S. Pharmacopoeia. The Pharmacopoeia is the legal standard for drugs and medicines in the United States.

The purity of the fluid extract of ergot marketed in this country was questioned several years ago by Howard W. Ambruster, New York importer, and became the subject of intense controversy and a congressional investigation. It is understood that Ambruster's charges, however, have nothing to do with the present revision.

Dr. M. I. Smith, pharmacologist of the U. S. National Institute of Health in Washington, devised a new standard for the drug and a method of standardization. The standard proposed by Dr. Smith is the same as the one being adopted by the Pharmacopoeia, though the new official method for making a drug that meets this standard is not the method he devised.

Physicians, pharmacologists and pharmacists have recognized for some time that the fluid extract of ergot, as manufactured commercially, was not up to standard. Believing that for this reason the drug might endanger the lives of mothers and new-born babies, many physicians stopped using the drug in confinement cases.

The new standards, which are expected to bring about

a more uniform and safer product, are merely part of the revisions which are constantly being made in the U. S. Pharmacopoeia to keep it abreast of the latest scientific developments. The entire book is revised once every ten years, and revisions such as the one for ergot are issued in the intervening years.

MEN OF THE OLD STONE AGE IN GERMANY

LIONS were among the beasts at which hunters of the Old Stone Age in Germany cast their spears. Evidence to this effect, in the shape of a fine skull of a lion, has been found at what seems to have been a hunting-place of Ice Age date near Wallertheim in the Rhine region. The discoverers, Professor Otto Schmidtgen, director of the Mainz Museum of Natural History, and Dr. Wilhelm Wagner, of the Darmstadt Geological Institute, have been conducting a systematic search for evidences of paleolithic populations in the Rhineland.

The hunting-place where the lion skull was found seems to have been a water-hole where the animals came to drink, and where consequently their shaggy hunters could lurk among the bushes with fair hopes of spearing a dinner. Tools of both stone and bone were discovered here, the latter a great rarity among Old Stone Age artifacts. The tools so far found are of such rough shape that their discoverers doubt whether they were the actual hunting weapons. They think it more likely that the hunters flung spears of pointed, possibly fire-hardened, wood.

Professor E. Wahle, of Heidelberg, has expressed the opinion that the Rhineland will eventually provide data for the study of ancient man that will rival if not surpass in value the information yielded by the famous pictured caves in France. The cave-dwelling men of France, he pointed out, lived for many successive generations and culture levels in the same caverns, so that there is no clear separation of their remains into distinct strata. On the other hand, the Rhineland hunters were dwellers in the open, and layers of earth accumulated between successive occupations of a site by different groups, which will make possible a study of their time-relations by the well-known geologic method of stratigraphy. The separation of different groups of human occupants in the Rhine Valley is sharpened by the fact that during the Ice Age there were several advances and retreats of the glacial front, with corresponding retreats of the human population and their later returns to the forgotten and buried camp sites.

ITEMS

MAN'S ever-present enemies, the crop-damaging insects, are attacking on many fronts as the year warms into the summer that is their most favorable season. Recent surveys by the U. S. Bureau of Entomology show that even at their present low values, the farmers' crops will pay heavy tribute to these alien enemies again this year. An extension of front is reported in the Mexican bean beetle sector. The beetles have been discovered at Monticello, Florida, and in southern Mississippi. This is the first southward extension of their holdings since their first discovery in northern Alabama in 1919. Among enemies of cereal crops, the chinch bug and the corn ear worm figure prominently; fruit aphids and plum curculio are raiding orchards, while the messy webs of the tent caterpillar are disfiguring roadside trees all the way from Maine to Maryland.

ACCUMULATING reports reveal that the past winter brought the worst damage in years to the Atlantic coast. Numerous buildings and shore structures were battered into a state of wreckage by stormy waves. Abnormal amounts of soil were stolen from the shore line by the sea. The damage is laid to a succession of extreme storm tides such as occur every 25 to 30 years. In intervening years it is the usual thing for damage to the coast to total millions of dollars, but in years of storm tides the losses pyramid. In editorial comment on this serious property loss, *The Engineering News-Record* calls upon coast states to take defensive action. Local protective measures against storms and tides are of little effect, it is pointed out, because resistance of any one section of the shore line is interwoven with the resistance of adjoining sections.

A METHOD of adding copper and iron salts and manganese to milk has been developed at the University of Wisconsin by Professor E. B. Hart and associates. This new treatment makes milk more nearly a perfect food on which man or other animals could live exclusively. Despite its tremendous food value, it was found several years ago that milk could not be relied on as a sole source of nourishment. Animals fed solely on milk died of anemia. Professor Hart and associates were among the first to discover that this was because milk was deficient in copper and iron salts, necessary for production of hemoglobin. Manganese has recently been found a necessary element of diet also. The effect of the milk which has been mineralized by Professor Hart's new process has been tested on experimental animals and on one of the students at the university. This young man lived for two months on a diet of this mineralized milk. He did not lose weight and he never complained of hunger. Yorkshire pigs kept on an exclusive diet of this milk and cod-liver oil for four and one half months averaged the same weight at the end of the period as pigs fed the usual full diet.

GERMAN physiologists have worked out an ingenious method for estimating the velocity of blood circulation, which depends on the peculiar light reaction of the dye-stuff fluorescein. The presence of this dye in the blood is indicated by a greenish color of the lips, viewed under pure blue light in a darkened room. In making a test, a small amount of fluorescein solution is injected into the blood stream, and the number of seconds it takes until the lips shine with the greenish light are noted. The method is being used in the study of various circulatory and cardiac disorders, and also in research on the physiological effects of sports. The minimum circulation time thus far observed has been seven seconds; an average circulation time is approximately twenty-one seconds.

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SCIENCE NEWS

Science Service, Washington, D. C.

THE USES OF SPECTROSCOPY

METHODS of putting the rainbow to work by means of the spectroscope were discussed last week at the International Conference on Spectroscopy at Massachusetts Institute of Technology. Over one hundred scientific men and industrialists by attending showed their interest in the spectroscope, which is one of the most powerful tools for research. It has innumerable uses and in various applications serves as a watch, detective, balance, speedometer, microscope, camera, tape measure, transit and forgery detector.

In addition to spectroscopists from this country and abroad, those attending included industrialists and investigators working in textiles, chemical engineering, explosive manufacturing, metallurgical engineering, astronomy, medicine, biology, coal mining, automotive engineering, paper manufacturing, wire making. Many uses of the spectroscope were reported.

One engineer had trouble with automobile radiator caps buckling. The spectroscope revealed impurities in the material undetectable by other means. Another told of a white paint which turned black on exposure to sun. Spectroscopy revealed minute impurities.

The importance of the spectroscope in metallurgical engineering was indicated by the fact that one company has made more than 33,000 spectroscopic photographs during research.

In crime detection the spectroscope has enabled investigators to identify materials on clothing.

A coal operator said that it can be told by spectroscopic examination from what seam coal comes. Mining engineers are using spectroscopes to detect minute impurities, which in some cases aid in finding larger amounts.

Because even small amounts of impurities may affect the life of rubber, manufacturers are greatly interested in spectroscopic methods of detecting them. These methods are also of great use in controlling the manufacture of optical glass.

In food industries, the spectroscope is valuable in checking ultra-violet irradiation and in analysis of materials. Dental researchers have found by spectroscope that mottled enamel is due to small impurities in certain drinking waters. In the case of an appendix operation where glass was found, the spectroscope revealed that the fragments did not come from a suspected catsup bottle in a restaurant.

Other instances of the use of spectroscopy ranging from examination of cranberries to raincoats, cable sheathing, gasoline and transformer oil were cited. One company suspected second-hand oil was being sold for use in transformers. The spectroscope confirmed it.

In discussion of light-wave standards, it was emphasized that the iron standard is not obsolete but will be supplemented by copper which gives wave-lengths of value in the region below one one-hundred-thousandth of an inch long. Here iron does not give enough lines to be satisfactory for standards.

Of special significance at the meeting was the large attendance of industrialists who, while not trained in spectroscopy, realize its possibilities for their industries and want to learn how they can utilize it.

IMAGE OF A FAINT LIGHT

FAINT light may be incapable of forming a distinct image of a very small area.

This extension of the uncertainty or indetermination theory of the new physics is being tested by Professor John Q. Stewart and Dr. A. M. Skellett at Princeton University in a photographic study. Preliminary results reported in a letter to *The Physical Review* seem to show that scratches on a glass plate are fuzzier in focus when photographed in very faint blue light than when photographed in bright light.

One of the philosophically intriguing consequences of the new wave mechanics in physics is the uncertainty principle of Heisenberg, who, in 1927, pointed out that it is possible to measure the exact position of a small particle, such as an electron, only at the expense of uncertainty as to its position. This principle of indetermination has been more disturbing to the older physical concepts than even the principle of relativity.

Three years ago Professor Stewart, reasoning by analogy, speculated that this matter of uncertainty might extend to faint light forming images. Since then he and his associates have been carrying out tests.

The source of light is a pinhole in a dark room, the pinhole being illuminated from behind through a blue filter. At a distance of 2.5 meters (about 2½ yards) is mounted a glass slide having numerous fine scratches forming a scale of tenth millimeters. A sturdy camera photographs these fine markings using only light from the pinhole. Faint light exposures varying from an hour or two up to twelve days have been made and compared with bright light exposures. The faint light exposures show a decidedly more blurred focus than the photographs made with brighter light. The experiments are being continued.

THE HUMAN EGG-CELL

THE importance of quality in human egg-cells is stressed by Dr. George L. Streeter, director of the department of embryology of the Carnegie Institution of Washington, in a report on his most recent investigations. As many as 25 per cent. of fertilized ova are not good enough to reach the stage of birth, he says. Such biological false starts die at some time during the prebirth period.

Even after birth, however, the influence of the egg-cell's make-up still continues, according to Dr. Streeter. "Whether the infant survives its first year—and in fact a large number of them fail to do this—depends in considerable part on the original quality of the egg," he continues. "If they withstand the usual experiences of life until between 50 and 60 years old and then succumb to its aggregate wear and tear, they conform to the

actuary's 'expectation of life at birth' and to the embryologist's expectation of the performance of an egg of average quality. It is only the extraordinarily good egg that is still going strong at 80 years, and we see him (or her) do this in the absence of any exquisite hygienic régime or environmental favor.

"The egg as a whole, of course, consists of a multitude of elements and it is the sum, or rather integration of these, that determines its fate. If we would know the quality of the egg, we must therefore determine the quality of its parts. As a whole the egg may be a satisfactorily performing mechanism, although certain portions of it are of poor quality. One finds, in fact, that it is normal for the component elements of the egg to differ among themselves in such qualities as endurance and capacity for growth. One also finds that these differences vary in different eggs and that they are hereditary."

PERNICIOUS ANEMIA

PERNICIOUS anemia is not necessarily the result of the lack of the preventive vitamin B_2. Failure to digest this vitamin, even though it is present in the stomach, may also bring on this troublesome illness. So physiologists and medical scientists attending the meeting of the American Association for the Advancement of Science were informed by Dr. Maurice B. Strauss and Dr. William B. Castle, of the Thorndike Laboratory, in the Boston City Hospital and the Harvard Medical School.

Pernicious anemia, their report stated, may result from the failure of the stomach juice to digest vitamin B_2 or a closely related substance. Vitamin B_2 is found in meat, eggs, milk, liver, the outer layer of rice, yeast and wheat germ. Without any symptoms of indigestion, such as gas or pain, the patient may lose an essential factor from the stomach juice with the result that pernicious anemia develops. This stomach factor is neither the stomach acid nor common ferments, so that its absence can only be detected by special biological tests. All the usual factors of the stomach juice may be absent, but this very necessary one still remains.

If this factor is absent, no matter how much food containing B_2 the person eats, the anemia will remain. However, if every day he drinks two or three ounces of stomach juice from a healthy individual after he has eaten foods containing vitamin B_2, the anemia will be cured.

In pregnancy certain women lose this stomach factor temporarily. They then develop pernicious anemia of pregnancy. After they have had their children this stomach factor returns to normal, and they recover from the anemia. Other women, in order to keep their figures thin during pregnancy eat so little food containing vitamin B_2, that they too develop anemia, even though the stomach juice remains normal. Both factors are necessary to keep the blood normal.

In India and other tropical areas there is an anemia very much like pernicious anemia. Individuals with this disease may have a normal stomach juice, but may have eaten so little vitamin B_2 containing food that they develop the same kind of anemia as people whose stomach juice is abnormal.

ITEMS

STUDY of the cosmic rays has taken an Indian physicist to high ridges of the Himalayas 19,500 feet above the sea. The mountain climb is part of the world-wide cosmic ray survey organized by Professor A. H. Compton, of the University of Chicago. By gathering data on the intensity of the rays from space as they strike the earth at different altitudes and in different latitudes, physicists hope to learn the character of this radiation. Reporting his journey, to the Urusvati *Journal* of the Himalayan Research Institute, Professor J. M. Benade expresses the belief that he has carried the cosmic ray search to a new height record for mountain work. Professor Benade is professor of physics at Forman Christian College, Lahore. His part in the world survey is to take measurements of rays in Ceylon, Java, Singapore, Penang, Rangoon, Calcutta, Lahore, and at the highest attainable altitudes in the Himalayas.

COSMIC rays entering the earth must consist in part of both negative and positive charged particles. For if the particles were only electrons or only positives, mathematical computations show there would exist electric potential differences of thousands of billions of volts between points that are relatively close together as astronomy counts distances, such as the distance light travels in a year. This suggestion was made by Dr. W. F. G. Swann, director of the Franklin Institute's Bartol Research Foundation, in a communication to the American Physical Society. Some investigators have suggested that the cosmic rays consist of a mixture of electromagnetic radiation or photons and negatively charged particles or electrons. Recent experiments by Dr. Swann's associates have produced evidence that some of the particles may be speeding hearts of light atoms, positively charged. Dr. Swann renews his theory that the cosmic rays may originate in the heavenly bodies and sees no theoretical reasons why both negative and positive particles should not be emitted with high energy from them.

BY projecting a magnified image of the impression of a star on a photographic plate to a small white screen, astronomers at the Yale University Observatory are measuring these plates with much less eye-strain than formerly. In much of this work the actual plates are measured under a special form of microscope whose motions back and forth and up and down can be accurately determined. The strain of examining these images through the microscope eyepiece, then reading the micrometer heads that tell its motion, then recording the readings, is often considerable. Dr. Frank Schlesinger, director of the Yale Observatory, and his associate, Dr. Arthur L. Bennett, have developed the new method, in which a powerful light shines through the plate, then through the microscope. Above is a small mirror which reflects the light downwards to a white screen made of magnesium carbonate. The entire apparatus acts as a magic lantern, the plate being the slide, and the image on the screen may be magnified thirty diameters or more. This overcomes much of the usual strain, and comparative tests show that there is no decrease in accuracy.

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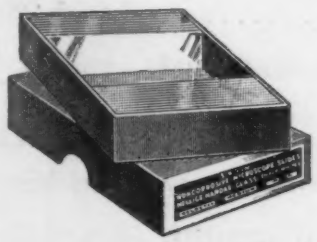

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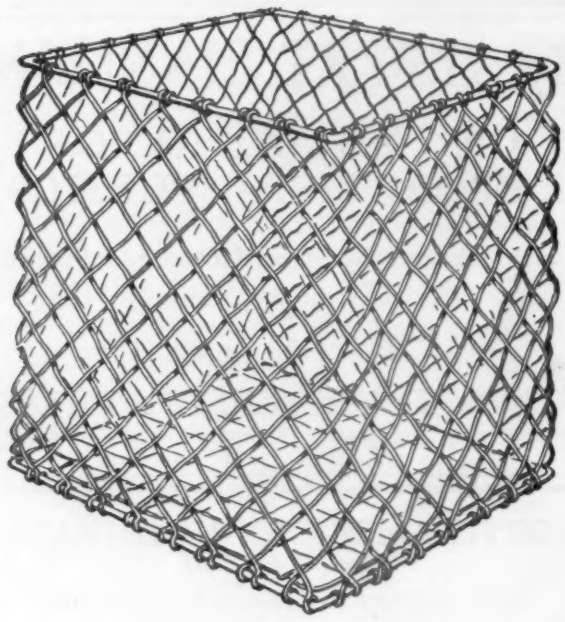

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SCIENCE NEWS

Science Service, Washington, D. C.

THE "PEKING MAN"

THE famous fossil, "Peking man," whose unearthing during the past few years in a cave near Peiping, China, has added an early chapter to human pre-history, was introduced to the International Geological Congress by the group of scientists responsible for his discovery.

Sinanthropus, as this fossil man is known scientifically, is now recognized to be one of the earliest of humans, rivaling the famous ape-man of Java, Pithecanthropus, in antiquity, and dating from the earliest stage of the Pleistocene, that portion of the record of the rocks that included the great Ice Ages. Although relatively young in the history of the earth, this time is hundreds of thousands of years in the past; just how many, geologists do not as yet attempt to say with accuracy.

Dr. Davidson Black, Canadian by nationality, anatomist by profession, and directing the Chinese Geological Survey's inquiries into the recent geological past of China, acted as spokesman for the group.

More is known about Sinanthropus, China's fossil man, than any other extremely ancient human creatures, Dr. Black said. Skulls and nearly complete jaws of an adult and child have been found, and out of the débris of the Choukoutien cave where Sinanthropus must have lived for thousands upon thousands of years, a large quantity of other bones and teeth has been dug.

Only in this one locality, a cave uncovered in limestone quarrying near the little village of Choukoutien, about 25 miles from Peiping, has evidence of Sinanthropus been found. There, in 120 feet of layered dirt of ages, are found mingled the bones of Sinanthropus, bones of extinct animals, man-made tools of bone and stone, charcoal from fires that burned and cooked Sinanthropus' meals ages ago.

In scientific language Dr. Black explained how excavations and studies had caused China's fossil man to arise from this cave rubbish heap and become a link in man's common ancestry with the rest of the animals.

Not a great-ever-so-great grandfather, but rather a remote uncle, is Sinanthropus to modern man. Dr. Black and his associates feel sure Sinanthropus was not a direct ancestor of our own particular Homo kind of human being, but that he was nevertheless human in the true sense of the word. He was in a blind evolutionary alley, an off-shoot from the main stem of mankind's evolution that died out some time later in the course of time.

Despite the remote antiquity of Sinanthropus as measured by the geological layers of the earth, the chert, limestone and quartz implements that he fashioned are relatively advanced and have some characteristics that indicate that he might have been as skilled as the Mousterian men in Europe who were by no means the earliest of the inhabitants of Europe.

Truly international is this search for ancient man in China, organized by the National Geological Survey of China. At this International Geological Congress was Dr. Black, honorary director of the Cenozoic Research Laboratory, a special department of the National Geological Survey of China, generously supported by funds of the American Rockefeller Foundation. There was Père Teilhard de Chardin, Jesuit priest and native of France, lately president of the Geological Society of France, whose paleontological researches are world famous. He greeted with affection Sir Arthur Smith Woodward, the British scientist, with whom he was working when he found the canine tooth of the famous Piltdown man. Also representing China at the congress was Dr. V. K. Ting, scholar and gentleman of the world and honorary director of Cenozoic Research in China. He is a leader in Chinese science and an authority on the relationships between fossils and rocks in China.

THE EXPANDING UNIVERSE

A FEW billion years ago all the galaxies were together in a space no larger than is now occupied by one of them, but they at once began to separate, so starting the expansion of the universe.

This theory was presented to the Royal Astronomical Society in London by Professor Willem de Sitter, the Dutch astronomer, whose previous theories of an expanding universe were accepted by a large number of physicists and mathematicians. He has lately changed his views, he said, as to the origin of the expansion.

"We have to choose between three types of expanding universe," according to Professor de Sitter.

"The first type begins with zero radius at a finite time in the past, and expands to infinity. The second contracts from an infinite radius to a minimum and expands again to an infinite radius, while the third oscillates in a finite time between zero and a maximum radius.

"The third type involves a periodically recurring catastrophe, a theory of which I have a very strong dislike. Until recently I was inclined to believe in the second type.

"Lately I have come to think of the first case, where, according to the mathematical idealization, the universe contracted to a point at some definite epoch of time, the galaxies passing simultaneously through this point with the velocity of light. When the galaxies approach very near each other the mathematical approximation breaks down, so that the point becomes finite, and a physical interpretation is possible.

"The galaxies can easily penetrate each other. If you put a million galaxies in the space now occupied by one, the stars still have plenty of elbow room. Their mutual distances will still be of the order of 100,000 times their diameters.

"The truth of this theory depends on whether the time of passing through the minimum was a very critical epoch or not. It is supported by several indications of a serious crisis three or five billion years ago. The planetary system, according to modern ideas of its origin, is about that age. And a few billion years ago there

must have been some very critical event in the history of the galaxies, when they were subjected to very strong perturbations, which were responsible for their rotation, their spiral structure, and the inhomogeneous distribution of matter in them.''

SOIL EROSION

SOIL erosion that removes 126,000,000 pounds of plant food annually from fields and pastures of the United States, at a financial loss estimated at $200,000,000, will be fought with a public works fund grant of $5,000,000.

The soil conservation plan will be under the supervision of the Bureau of Agricultural Engineering of the Department of Agriculture, and the Special Board of Public Works in making the grant directed that the program be completed before November 1, 1934.

Terracing is the means to be used in controlling the erosion. The government will supply the technical direction and terracing equipment and the landowners will provide the power and labor.

A maximum amount of unemployment relief is promised for every dollar invested by the government. It is estimated that more than twice the $5,000,000 grant will be spent by landowners on labor and power in carrying out the work. Thus more than $15,000,000 will be put to work.

Agricultural engineers believe that the one-year program will provide for the terracing of approximately 4,752,000 acres of land and will supply 4,197,600 days of labor.

The Department of Agriculture estimates that 75 per cent. of the cultivated land in the United States is seriously affected by soil erosion. More than 17,000,000 acres of formerly cultivated land have been destroyed by erosion.

Conservation of the fertile top soil, one of the most important of agricultural assets, will tend to maintain the value of the land held as security for long-term loans, made directly or indirectly with government funds. It will decrease the deposits of silt and sand in bottom lands and stream channels and supplement and make more effective the program of gully control on private lands.

Funds will be allotted to the states in proportion to their cultivated areas as shown by the 1930 census.

SEA WAVES IN THE LABORATORY

WITH synthetic storms created in a miniature ocean contained in a concrete tank, Professor Kenneth C. Reynolds, of the Massachusetts Institute of Technology, hopes soon to be able to tell how to design sea-walls that will hold real storm waves at bay and prevent millions of dollars of damage to water-front property.

The institute's laboratory ocean, believed to be the first of its kind, is 20 feet long and 6 feet wide. A wedge-shaped plunger moving up and down at one end creates the miniature waves. From the moment they start rolling shoreward to break upon a sandy beach and hurl themselves against the tiny sea-wall, their behavior is observed. As they break against the sea-wall and toss spray several feet high, which is equivalent to from 25 to 60 feet in the majestic scale of nature, they carry sand and pebbles beyond the wall just as the sea does on innumerable Atlantic seaboard beaches.

The experiment continues for a time and then the amount of sand which has been carried over can be measured. With the same storm conditions a different height of wall or a change in shape of the face may be tried until the best design for a given beach section can be obtained. Waves from various directions and for different high tides will be imitated so as thoroughly to investigate the entire subject.

In the tests thus far made, the sand often has become undermined near the wall just as it does in nature. Methods for remedying this are to be investigated as well as the effect of breakwaters or other forms of offshore protection.

The best design in the miniature having been found, the results will be transferred to nature, thus eliminating the great waste now involved in trying out and altering this or that expensive scheme in a vain attempt to decrease this enormous annual property damage.

ITEMS

WOLF'S periodic comet has been sighted through Lick Observatory's giant telescope manned by Dr. Hamilton M. Jeffers. It returns to the vicinity of the sun after a journey into space that has lasted seven years. It is extremely faint and eighteenth magnitude. It is located in the constellation of Sagitta, the arrow, visible now in the eastern evening sky. Its astronomical coordinates are: right ascension 20 hours 7 minutes 57.2 seconds, declination north 22 degrees 4 minutes. First discovered in 1884, this comet was last seen in 1925. It is one of the periodic comets whose return was confidently predicted by astronomers.

SMALLPOX vaccine virus from chicken eggs instead of from calf lymph is the achievement of Colonel W. D. H. Stevenson and Dr. G. G. Butler, of the British Government Lymph Establishment. Their method will be reported in the forthcoming issue of *The Lancet*. The new method opens the possibility of large-scale production of a bacteria-free virus for vaccination, it is claimed. From twenty-eight eggs the investigators obtained enough material to vaccinate seven thousand persons. Commenting editorially on this new method, *The Lancet* points out that the new vaccine is sterile; that the method is not as arduous or expensive as the production of calf lymph, and that the yield is excellent. The method seems to represent a definite advance and to be free from the objections to which calf lymph is open. Other investigators have tried to produce a similar vaccine virus. The method reported by Colonel Stevenson and Dr. Butler is said to be a modification of the technique developed by A. M. Woodruff and Professor E. W. Goodpasture, of Vanderbilt University.

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SCIENCE NEWS

Science Service, Washington, D. C.

X-RAYS PRODUCED BY POSITIVE PARTICLES

"POSITIVE" x-rays can now be produced at a million volts instead of the few thousand necessary for ordinary or "negative" x-rays.

Positive x-rays are produced in a vacuum by the impact of positively charged ions, or atoms that have lost an electron, on a metal target; whereas negative x-rays, found by Roentgen in 1895, are produced by fast electrons.

Dr. W. M. Coates and Professor E. O. Lawrence, of the University of California, have stepped up mercury positive ions to 1,000,000 volts and on allowing them to strike targets of various elements have observed that real x-rays are given off.

Ever since Roentgen's original discovery of the common "negative" x-ray that has played such an important part in modern medicine, physicists have been attempting to produce these rays by positive as well as negative projectiles. Sir J. J. Thomson, as early as 1914, observed a non-penetrating radiation from targets struck by protons or hydrogen positive ions, but the very softness or lack of penetrating power of the radiation proved that this was not a positive x-ray.

Even Drs. J. D. Cockcroft and E. T. S. Walton, of the University of Cambridge, the pioneers in nuclear disintegration by high velocity protons, found no appreciable quantity of this positive x-radiation at projectile speeds equivalent to 700,000 volts. It remained for F. L. Verwiebe, of the University of Chicago, to settle the question as to the exact nature of the Thomson radiation resulting from proton bombardment.

At energies up to 50,000 volts he found that the hardest radiation given off was not due to the metal being used as a target but to the changes in the bullets themselves at the time of the impact. This is to be contrasted with the effects of Drs. Coates and Lawrence where the radiation has without doubt the same penetrating power as our ordinary x-rays, and where, from targets of the lighter elements the rays are characteristic of the targets, a true x-ray effect. However, for the heavier targets it is again the bullet itself that breaks up.

At present there are no prospects of utilizing this new method to produce better or cheaper x-rays. The process is remarkably inefficient as a million volt positive ion will produce only approximately the same quantity of x-rays as a ten thousand volt electron.

The scientific solution of the old problem as to the previous non-existence of positive x-rays is twofold—higher voltages and heavier projectiles.

THE BEHAVIOR OF SINGLE ELECTRIC PARTICLES

A GOAL of physics just now is to discover one single electron acting as a wave. To clarify some of the latest enigmas of the most advanced knowledge of our physical world, Professors P. L. Kapitza and P. A. M. Dirac, theoretical physicists at the University of Cambridge, have appealed to fellow experimental physicists to perform a crucial experiment, that of passing a beam of electrons through a double beam of light. They do not know how the experiment can best be done and they can only hope for success.

Since Prince Louis de Broglie showed that electrons have wave characteristics and Dr. A. Heisenberg, the German physicist, stated that absolutely precise simultaneous measurements of both the position and the momentum of a particle were impossible, physicists have been inquiring into the behavior of individual electrons. These experiments have always shown an uncertainty in one of the fundamental quantities measured.

The new scheme suggested by Professors Kapitza and Dirac is to let a green light shine on a perfect mirror and be reflected straight back. The superimposed waves of light will form a periodic field through which electrons will be shot at a definite speed. This field is expected to act on these electric particles which may also be considered as waves and bend them slightly.

It is hoped that the interference of the light wave field and the electron wave field will produce a pattern on a screen or detecting device, from which they may acquire new conceptions of the behavior of single electric particles.

LAND LEVELS IN THE NORTH

NORTHERN lands that bore the vast ice load of the Glacial Age for a million years now appear to be slowly rising, as one end of a raft rises in the water when a burden has been removed.

This is the interpretation of apparent changes in land levels in the northern United States, Canada, and the Baltic regions of Europe, by Dr. B. Gutenberg, of the California Institute of Technology. Dr. Gutenberg's study, based on data collected from many sources, appears in the current issue of the *Journal of Geology*.

The tiltings are very slight, as measured by the year—only about two fifths of an inch annually between Chicago and the northeastern part of the Great Lakes region. But if they have been going on for the past hundred thousand years or so they would amount to a good deal in the aggregate.

Dr. Gutenberg's suggestion is based on the theory, widely accepted among geologists, that the continents really are like rafts floating in water. They consist of masses of lighter rock, mostly granite, floating in a heavier rock that is not wholly rigid, but rather yielding under a burden after the fashion of the traditional molasses in January, or oozy asphalt on a hot summer street. The extreme viscosity of such "gummy" rocks would account for the fact that the continent-rafts are still tilting, though the last fragments of the great glaciers melted off the face of northern Europe some eight or ten thousand years ago.

If the northern ends of the continents are rising, a compensating sinking should be expected to the southward. Some evidences that such a thing is occurring have been obtained, but they are rather too equivocal to

be satisfying, and Dr. Gutenberg recommends further close study of the subject of sinking coasts.

FOREST COVER AND THE WATER YIELD

STRIPPING off the forest cover does not decrease the water which can be obtained from a given area of land; contrary to widely accepted beliefs, it actually increases the water yield. This disagreement with orthodox forestry creed is presented by W. G. Hoyt and H. C. Troxell, hydraulic engineers of the U. S. Geological Survey, as the result of experiments which have been conducted in two typical watersheds in the West, one of which was deliberately deforested, while the other lost a chaparral cover accidentally through fire.

By measuring the water yields before the forest cover was removed, immediately afterwards while the ground was still bare and through several subsequent years while the areas were growing up in brush, a considerable mass of comparative data was accumulated.

The total annual run-off from both sample areas was increased, 15 per cent. in the case of the cut-over forested area and 29 per cent. from the burned-over chaparral area. This is considered evidence that forests and brush do not "conserve the water supply." One very important factor in the reduction of water obtainable from a forested area, the two engineers hold, is the loss of great quantities of water through evaporation and transpiration.

Messrs. Hoyt and Troxell state that the increased run-off was not confined to sudden destructive flood periods, as the summer low-water flow was increased on one area 12 per cent. and on the other area 400 per cent. It was true, however, that the loss of vegetation did increase normal flood heights. They conclude, on the basis of these and other facts learned from the two areas studied, that reforestation for the purpose of increasing the annual yield or low-water stream flow will have an opposite effect.

They hold that change should be made in the concepts to be implied by the term, "watershed protection," maintaining that undue and, in the main, erroneous emphasis has been laid on the value of timber growth for "increasing water supply," "securing favorable conditions of flow," and "promoting and protecting navigation." They emphasize their belief that where watershed protection means "retarding erosion," "conserving soil," or lessening torrential run-off it may be obtained as well by a cover of shrubs or grass, which may use relatively little water, as by trees, which may consume large amounts of water.

PUBLIC WORKS ALLOTMENTS FOR SCIENTIFIC SURVEYS

MORE than $5,000,000 of the federal public works appropriation will be spent in mapping and surveying of the country and its waterways with resulting benefits to reviving industry, agriculture, shipping and mining now and in the future.

While this money will speed the eventual completion of the country's mapping, much of it will be used for wages and will be spent locally in communities widely scattered over the United States.

The allotment of $2,600,000 to the Coast and Geodetic Survey of the Department of Commerce will enable the Department to proceed with scientific work of surveying the nation's coast lines and the making of triangulations and elevation measurements in the interior of the country.

With regard to mariner's charts, the situation in respect to intracoastal waters of the Atlantic coast is particularly bad. Secretary Roper has pointed out that most of the surveys of these waters were made 30 to 50 years or more ago. Since that time both the forces of nature and the works of man have made radical changes in many sections. New charts based on new surveys will become of increasing importance with the expected increase in commerce and transportation. The money will also prevent the suspension of earthquake studies in California.

No action has been taken as yet on Secretary Roper's request for public works funds for testing work at the National Bureau of Standards in connection with the recovery program.

The U. S. Geological Survey in the Department of the Interior is another scientific agency of the Government which has secured relief for severe curtailments in funds through new allotments from the public works funds. In addition to the $1,200,000 which was recently allotted to this survey for construction and repair work, another allotment of $2,500,000 has been announced.

Most of this sum will be used for topographical survey work, which will employ the services of a great many engineers and technical employees. But it is understood that it will not relieve the situation for the scientific men in the survey. A small part of the allotment, $100,000, is to be used for investigation of underground water resources, and this work will employ some geologists and chemists. No public works funds have as yet been assigned for the geological work of the survey. Secretary Ickes had previously decided, however, not to dismiss the geologists slated to go because of lack of funds for salaries. Instead he instituted a system of staggering furloughs so that the survey can have the benefit of their expert advice at least during part of the time.

ENERGY FOR THE FUTURE

AMPLE energy for mankind's future use is contained in the sunshine, wind, tides and ocean heat. This is the conclusion of Dr. Arthur B. Lamb, professor of chemistry and director of the chemical laboratories at Harvard University.

Each year the world uses 17,800,000,000,000,000 kilogram calories or as much energy as is contained in 2,700,000,000 tons of coal; if our supply of natural resources were cut off, it would take the labor of 11,000,000,000 men—5 times the population of the world—to furnish the same amount of energy. At present, only 17 per cent. of this total is actual human energy, while coal furnishes 50 per cent. and the remainder comes chiefly from oil, wood, gas and the labor of domestic animals.

Even these present sources of energy represent but a small fraction of the available supply of coal, oil and gas. The untapped reserves of these three natural resources amount to 2,200 times the world's annual consumption of all kinds of energy, that is, at the present rate of

consumption, we can get along for a couple of thousand of years.

But this assurance, pleasing as it may be, is insignificant beside the tremendous stores of energy in sources as yet unutilized. Annual solar energy to the earth totals almost 42 times the energy of all the world's energy reserves in the forms of coal, oil and gas. If, for example, all the light energy that falls on Boston's 43 square miles could be converted into power, the output would surpass the total present output of power in the United States. Even the common winds, if harnessed, could deliver in one year 75 per cent. as much energy as could all coal, oil and gas sources during the next 2,000 years.

Another important source is the heat of the earth which would yield millions of times as much energy as all present sources but which, unfortunately, probably will not be tapped. Dr. Lamb points out that proposals to sink deep shafts into the ground and use the subterranean heat to generate steam are not feasible.

"Simple calculations show this is quite out of the question," according to Dr. Lamb. "The only hope is to take advantage of the accidental supplies of hot water, or better, of superheated steam occurring in certain volcanic regions, such supplies, for instance, as Count Conti has utilized with conspicuous success in Italy and which can doubtless be utilized in Sonoma County, California."

Other sources draw Dr. Lamb's attention. One possibility is the fuel cell which uses carbon or carbon monoxide as one depolarizer and the air as the other. At 1,500 degrees Fahrenheit, these cells deliver large supplies of energy and their use, at room temperatures, is not out of the question.

Another source is rain water. The annual yield of rain water in the clouds would, if harnessed, be sufficient at the present rate of energy consumption to satisfy all demands for the next 150 years.

Still other sources are being examined at present. Georges Claude is engaged in an attempt to utilize ocean heat economically. Tidal energy has been sought on a large scale, the most important current proposal being the Bay of Fundy plant which would yield over a half billion kilowatts. The photoelectric cell, still in its infancy as a commercial proposition, is expected to add further to this enormous store of energy which may some day entirely relieve mankind of the necessity of providing for its own economic welfare.

ITEMS

THE theory that tubercle bacilli may change from the bovine type to the human type in the body has been put forward by Colonel Nathan Raw in connection with a case of tuberculosis which he has reported in a recent issue of *The British Medical Journal*. Colonel Raw was a member of the International Committee for the Prevention of Tuberculosis. In the case reported, the girl's glands showed definitely the presence of bovine tubercle bacilli when she was a child. Eighteen years later she developed pulmonary tuberculosis in which the bacilli were of the human type. It is suggested that living bovine tubercle bacilli that are swallowed by infants may lie dormant in their new environment of human tissues and eventually be conveyed to the lungs before or after being changed into human tubercle bacilli.

CARBON monoxide, deadly gas of closed garages, may take toll of unborn generations, according to a report before the Phi Sigma Biological Research Society by Lloyd L. Wells and W. E. Batchelder, of the University of New Hampshire. Messrs. Wells and Batchelder, with their associates, gave repeated doses of an atmosphere containing one and one half per cent. of carbon monoxide to female rats about to produce litters of young. Some of the litters were born prematurely, others were absorbed back into the mother's body and not born at all. Many of the young rats that were born alive were not normal. It was found that a rat could build up a resistance to carbon monoxide, but this resistance was only temporary.

DISTILLATION and adsorption can now be used to concentrate heavy weight water out of ordinary water, Drs. Edward W. Washburn and Edgar R. Smith, of the U. S. Bureau of Standards, have determined and reported to the *Journal of Chemical Physics*. Electrolysis was the earlier method used by Dr. Washburn and his associates to manufacture water heavier than normal. The common sorts of hydrogen and oxygen, masses 1 and 16, are given off first as gases in electrolysis, leaving the remaining water rich in the double weight hydrogen and the heavier oxygen isotopes 17 and 18. Because the heavy water so made was found to have a higher boiling point, Dr. Washburn realized that it should be possible to fractionate water by distillation. He distilled ten quarts and the two portions obtained were found to differ in density by 65 parts per million. Water was also fractionated by allowing a mass of activated charcoal to stand for three weeks in water. The adsorbed water was found to be denser than the unadsorbed portion.

WE unconsciously apply certain simple mathematical criteria in our enjoyment of art, whether of plastic form or of musical sounds. This is in bare outline the thesis of a discussion before the Mathematical Association of America, presented by Professor George D. Birkhoff, of Harvard University. According to his theory of esthetics, certain elements of order are of fundamental importance; and it is the density of these elements of order that determines primarily the enjoyability of a work of art. These elements, he said, correspond in general to simple mathematical relations, and this suggests that esthetic enjoyment may arise in part from the intuitive appreciation of such relations. For example, primitive man doubtless enjoyed the beauty of form of the moon or sun because of an intuitive appreciation of the geometric relation of circularity. In the applications considered, the most important relations of this kind were found to involve geometry, the theories of groups and of periodic functions. It was only in this special sense, concluded Professor Birkhoff, that a connection was developed between mathematics and art, despite the fact that many writers from the time of antiquity have endeavored to establish a mystical connection between the two fields.

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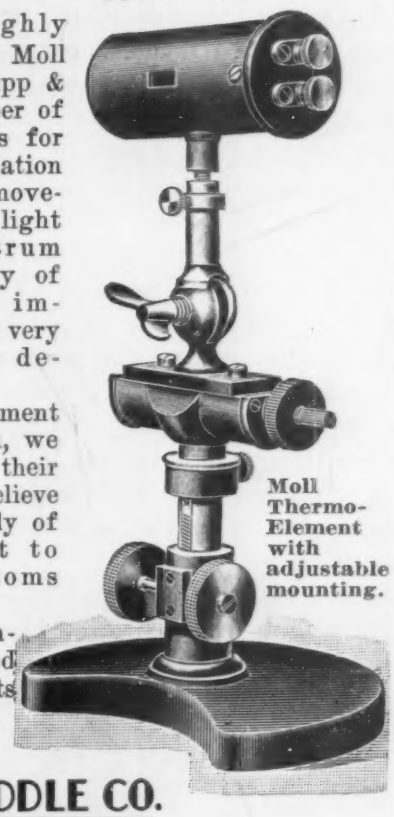

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GASTRIC ACIDITY

VERY acid condition of the stomach seems to go with youth and when found in old age is an index to a long life, it appears from a study reported by Drs. Zachary Sagal, Jerome A. Marks and John L. Kantor, of New York City, to the American Gastro-Enterological Association and published in the current issue of the *Annals of Internal Medicine.*

These physicians made 6,679 determinations of the amount of hydrochloric and other acids in the stomachs of nearly that number of patients having symptoms of digestive disorders. The patients were of all ages and came from many different walks of life. Here are some of the other interesting findings of this study, some of which confirm observations by other scientists:

There are several constitutional types with regard to gastric acidity, as well as with regard to other conditions of the body.

After constitutional predisposition, age is the dominating factor in gastric acidity. The greatest percentage of high stomach acidities was found in the fifth decade of life. This is the period when all bodily functions begin to decline, including stomach secretion. Diminishing amount of acid in the stomach may be considered one of the indications of approaching old age, such as loss of hair and teeth, diminishing activity of the glands of internal secretion and hardening of the arteries. Sex is also a factor, men having higher degree of stomach acidity at all ages than women.

Certain diseases are known to be associated with certain ranges of stomach acidity; for example, the acidity is high in duodenal ulcer, while hydrochloric acid is absent in pernicious anemia and cancer of the stomach. These acid levels seem to precede the disease, however, and Drs. Sagal, Marks and Kantor believe that the degree of acidity, which is a constitutional factor, predisposes to a certain disease, rather than that the disease produces the change in acidity. Regular determinations of the acid in a person's stomach, therefore, are recommended in order to watch for predisposing signs of disease, and also as a guide to treatment. For example, persons with a tendency to have too much acid in the stomach should avoid spicy and other foods that stimulate stomach secretion. Low acidity, on the other hand, calls for an entirely different diet.

In many cases of heartburn the New York doctors found little or even no acid in the stomach, and they point out that medicinal treatment should be guided accordingly. It would seem that baking soda, favorite home remedy for heartburn, may be all wrong in some cases. If the condition in a given case were due to too little acid, the soda, by neutralizing what acid there was in the stomach, would exaggerate the condition and aggravate rather than relieve the symptoms.

THE WHITE SPOT ON SATURN

A LARGE white spot, so immense that it could engulf an object over twice the diameter of the earth, has appeared suddenly on the equator of Saturn, the ringed planet and second largest of the solar system.

It was discovered by John E. Willis, of the U. S. Naval Observatory, at 12:18 A. M. Saturday, August 5, while he was observing a transit of Saturn as a routine operation, using the fixed six-inch telescope. Although he observed the planet for only about a minute before it left the field of view, Mr. Willis recognized the spot and called upon other astronomers at the observatory to check his discovery. Principal Astronomer H. E. Burton turned the 26-inch telescope and a smaller 12-inch telescope upon the planet and confirmed the discovery. B. P. Sharpless also made confirming observations.

Captain J. F. Hellweg, superintendent of the observatory, reported the discovery to Harvard College Observatory, whence it was bulletined to observatories throughout the world in order that they might join in the study of this unusual phenomenon.

Just what causes the white spot is unknown. Saturn is made of the lightest stuff of any planet, with a density one eighth that of the earth or seven tenths that of water. The equator of the planet, which is in line with the plane of its rings, is known to move faster in rotation than the other parts of the planet. Perhaps the white spot is a gigantic whirl in Saturn's equatorial belt.

On Saturday morning it was estimated that the spot was about a tenth the diameter of the planet, but on Saturday night Principal Astronomer Burton, with the 26-inch telescope, found that the spot was much larger. While difficult to measure because not well defined, the spot seemed to be about 20,000 miles long and 12,000 miles wide, being formed by a sort of extension in the brighter equatorial belt of the planet. It is expected that it will continue to be observable for several weeks.

Only twice before do astronomical records show that such spots have been observed on Saturn. The first was seen through the same 26-inch Naval Observatory telescope in 1876 by the late Professor Asaph Hall, Sr., just three years after the telescope was built. By using the spot as a mark of reference, Professor Hall was able to make the determination of the period of rotation of Saturn that is now quoted in astronomical tables, 10 hours, 14 minutes, 24 seconds. The 1876 Hall spot was not so large as the Willis spot now visible. Mr. Willis used the Hall determination of Saturn's period of rotation in predicting when the spot would return to visibility, and Saturday night's observations showed that the Willis spot is revolving around on the planet in about the expected time. The second spot on Saturn was discovered by the late Professor E. E. Barnard, of the Yerkes Observatory, in 1903. Unlike the Hall and Willis spots, the Barnard spot was considerably north of the planet's equator.

The spots are useful in making measurements of Saturn's rotation, but Sir William Herschel made a close determination of the planet's period of rotation in 1794, without the aid of a spot. He came within 2 minutes of the value later determined by Professor Hall.

HEAVY WATER PREVENTS SEEDS FROM SPROUTING

PROFESSOR GILBERT N. LEWIS, of the University of California, has discovered, through the first biochemical experiments made with the double-weight hydrogen isotope, that the new "heavy" water, one of science's latest discoveries, prevents the sprouting of seeds and may actually kill them.

Professor Lewis put some minute tobacco seeds in tiny test-tubes that contained ordinary water. Others he put in tubes of the special heavy water containing only double-weight hydrogen. The seeds in ordinary water sprouted. Those in the new heavy water did not.

From theoretical considerations, Professor Lewis predicted that water made with the heavy hydrogen would not support life and would be lethal to higher organisms. This was the first chance to test his theory. He will now determine whether the seeds placed in heavy water were merely inhibited or actually killed.

The heavy water used in these experiments has two atoms of hydrogen and one atom of oxygen, just as all water has. It is represented by the same familiar formula, H_2O. But all the hydrogen in the heavy water used has its heart or nucleus twice as heavy as the common hydrogen nucleus, and so the weight of the rare water is increased due to this heavier constituent, known as hydrogen isotope of mass two. Professor Lewis has made a report to the *Journal* of the American Chemical Society.

THE SUN'S TEMPERATURE

ASTRONOMERS have made many guesses at the temperature of the interior of the sun from 10,000,000 degrees Centigrade up, but the limit is less than 100,000,000 degrees Centigrade (180,000,000 degrees on the common Fahrenheit scale) if new evidence on the disintegration of light elements is correct, according to a statement made by Dr. Edwin McMillan, of the University of California, in *The Physical Review*. Astronomical evidence for this temperature is based on the heat necessary to balance the pressure of more than 9,000,000 tons to the square inch that exists at the center of the sun. Dr. McMillan has made his estimate from the relative amounts of lithium in the sun.

This terrific heat would be sufficient to transform the heavy lithium number seven into its lighter twin number six. Examination of pictures of the sun's spectrum taken by Dr. Arthur S. King, of the Mount Wilson Observatory, showed Dr. McMillan that the quantity of the light lithium in the sun is not much greater than on the earth. A temperature of 180,000,000 degrees would jostle the cores of hydrogen atoms in the sun about with a speed equivalent to that given by an accelerating electrical field of 10,000 volts and this speed has been found to be sufficient to break down the heavy lithium in the laboratory. But since there is no excess light lithium on the sun it can not have this enormous temperature unless some unknown process keeps building up the heavy twin.

THE PHOTO-ELECTRIC EYE

IN modern buildings doors will open when you approach and your questions may be satisfied by a reply: "The photoelectric valve." But questions in regard to the action of one of the newer type of cells have just been answered.

Professors J. Kunz and J. T. Tykociner, of the University of Illinois, have succeeded in explaining the mechanism of their particular kind of light-sensitive valve nine years after its discovery. The electric eye or switch looks much like a dumb-bell. It is the narrow handle between the knobs that will turn on the electricity when light shines on it. This valve differs from the ordinary photoelectric cell which was discovered early in the century and which was so beautifuly explained by Professor Albert Einstein in 1905.

The ordinary kind of cell generates a very small electric current by the action of light knocking out electrons from a sodium or potassium plate. The newer valve has a hot wire in one of the balls and the electrons given off from this filament are attracted to the other ball by an electric potential or voltage; the flow of these electrons is an electric current. When the valve is kept in the dark these electrons going through the small connecting tube are stopped by the repulsive forces of free electrons on the potassium plated inner walls. But let even the weakest candle illuminate this tube and the free guardian electrons are reduced in number, allowing the trapped electrons to rush on to their goal.

The advantage of the new valve is the large quantity of these moving electrons available from the heated filament. Larger currents are generated and do not have to be so greatly amplified to perform robot tricks.

EARLY MAN IN AMERICA

REPORTING the discovery of new evidence that America was inhabited some 15,000 years ago, Edgar B. Howard, anthropologist, who is excavating for the University of Pennsylvania Museum and the Philadelphia Academy of Natural Sciences, is of the opinion that this continent must have had human inhabitants older than the basket makers and the other types of Indians whose manner of life is known to-day.

The basket makers were the oldest Indians whose life in America is clearly pictured. They were farmers, living in caves in the Southwest during an early stage, and later building houses. Their arrival on the scene in the Southwest is generally estimated at about 1,500 B. C.

At old lake beds near Clovis, New Mexico, Mr. Howard's expedition found matted masses of bones of mammoth, and of extinct species of horse and bison, and what are believed to be camel bones. From the position of the skeletal remains, Mr. Howard reconstructs a scene where animals in a mad desire for water trampled one another into the mud. The bones of these extinct animals are near the surface. No human bones have yet been found, but numbers of stone spear points, knives and scrapers have been found in the same lake beds and near the ancient animals.

Earlier excavations by Mr. Howard in a cave near Carlsbad, New Mexico, revealed hearths buried at various levels down to a depth of over eight feet. Men who built fires in the cave had left there the bones of animals they killed and dragged into the cave for food. Musk-ox

and bison were the big game of the earlier of these hunters. Some of their stone spear points were also among the débris of the hearths.

Finding musk-ox bones in such association led Mr. Howard to set the age of these hunters at no less than 10,000 years before the Basket Maker Indians. Musk-oxen are cold weather animals, inhabiting to-day the frigid north. When the last glacial sheet moved northward, the musk-oxen and other cold weather animals that had been scattered widely over this country were forced to follow the retreating glaciers. New Mexico's last musk-oxen must have died out or departed then, it is believed.

DECREASE OF TUBERCULOSIS

ALMOST an entire year has been added to the general average duration of life by America's successful battle against tuberculosis within the decade from 1920 to 1930, according to statisticians of the Metropolitan Life Insurance Company. About another year's gain stands to the credit of the previous decade. That so much has been accomplished in increased life expectation through attack on a single disease is considered to be "very remarkable and gratifying."

According to the mortality statistics of the recent census year, 1930, the curtailment of the average length of life due to tuberculosis was just over one year for white persons of either sex. In 1920 it was a little short of two years. Still another decade further back in time it was about three years. The loss of potential years of life through a given cause depends not only on the degree of the mortality from that cause, but also on the age period at which its effect is concentrated. In this respect tuberculosis is in a particularly unfavorable position. Deaths from tuberculosis occur very largely among young persons or persons at the prime of life. As the result of this, although the death rate from tuberculosis has fortunately decreased in late years so far as to relegate this cause to the seventh rank among the principal causes of death, yet the number of years of life lost, on the average, is still a relatively important item.

Among white persons in the United States in 1930, the average length of life or the expectation of life at birth is shortened by 1.1 years through all forms of tuberculosis. Up to about the twentieth year of life the curtailment of the average remaining after-lifetime by tuberculosis remains nearly the same, irrespective of age, namely, about one year, according to the mortality as of 1930. After this age it falls rapidly. The situation is strikingly different in the case of heart disease. There the loss of years of life was nearly the same for all ages up to 52 years, and only slightly less even at the age of 62.

ITEMS

ARTISTS' crayons from agricultural wastes are a possibility as the result of recent studies at Iowa State College. By treating furfural, an oily, yellow liquid made from oat hulls, with various simple chemicals, a black material suitable for artists' crayons has been made. Tests show that crayons made from the new material are satisfactory in actual use in comparison with charcoal. By varying the chemical treatment given the furfural, crayons of varying degrees of hardness and blackness may be secured—a thing impractical with charcoal but desirable from the artists' standpoint.

BLOOD transfusions may be carried on more rapidly and conveniently than in the past, through the use of a new electrically driven "artificial heart" which is interposed between the blood donor and the receiver. The "heart," which is the invention of a Paris surgeon, consists of a small rotary pump which gives the transfused blood a "boost" with impulses simulating those of the natural pulse. Among other advantages claimed for the device is the elimination of chemicals which are frequently added to prevent clotting in the older type of transfusion operation.

FORESTS of spruce, fir, pine and larch, like those of present-day Canada, stood in central Illinois during a part of the great Pleistocene ice age. Evidence to this effect has been gathered by John Voss, of Peoria, Illinois, and is presented in the *Botanical Gazette*. Mr. Voss gathered samples of buried logs, leaves and other plant remains from thick peat deposits of known ice age date in three widely separated localities. When his material was identified in the laboratory, it proved to represent trees like those of the present forests of the North.

SWEDEN, which has the largest herds of moose in the Old World, also has the distinction of taking the best care of the animals. There are at a rough estimate 30,000 moose in Sweden, mostly in the central and southern parts of the country. The open season lasts only four days, during which any one can shoot as many moose as he can, but only on his own land. Large landowners may get a longer season by paying a special license fee, which goes into a fund for the conservation of the moose. Moose in Germany suffer unduly because the hunting season coincides with the mating season, during which it is easy to approach unnoticed within range of the excited animals. In Sweden the mating season of all game animals is closed against hunting. Word comes from Siberia that the moose there are decreasing. In the upper Lena River region the annual kill among the native tribes now averages only one animal per family, whereas it used to be as many as twenty.

SUGAR-CANE makes sugar of the relatively simple glucose type before it produces cane-sugar. The cane-sugar is manufactured in the plant through the action of an enzym or ferment known as invertase. Evidence supporting this theory has been found by Dr. Constance E. Hartt, a Honolulu plant physiologist specializing in the activities of the sugar-cane. Dr. Hartt has sent a preliminary report to *The Hawaiian Planters' Record*, and announces that fuller technical results will soon be published. Invertase, which has the power of turning the glucose type of sugars into the cane-sugar type, was always found abundantly in the parts of the cane where the manufacture and storage of sugar were going on most actively. In the older, more mature parts of the stalk the enzym was present in notably lower concentration.

SCIENCE NEWS

Science Service, Washington, D. C.

NOVA OPHIUCHI NUMBER THREE

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NEWS of a stellar catastrophe that happened possibly several thousand years ago has reached the earth. Watching from his private observatory in the middle of a cornfield near Delphos, Ohio, Leslie C. Peltier noticed a sixth magnitude star in the constellation of Ophiuchus in a spot where his charts indicated no star of that brightness. Thus, to his record of the discovery of several comets, he has added one of a new star, or nova, as astronomers call them.

Mr. Peltier did as astronomers always do when they make a new discovery. He notified the Harvard College Observatory at Cambridge, Massachusetts, which acts as a clearing house to distribute news of discoveries to observatories.

A nova is not really a "new" star that is suddenly created out of nothing. It is a faint star that suddenly becomes bright, sometimes exceeding any other star or planet.

Though Nova Ophiuchi Number Three, as the new discovery will be called because it is the third recorded in that constellation, is now just too faint to be seen with the naked eye (magnitude 6.4), this is probably because of its great distance, which has not been measured. Perhaps it has not yet reached its maximum brilliance and if that is so and it becomes much brighter, it will be visible without the aid of a telescope.

Ophiuchus, which means the serpent carrier, is now visible in the southwestern sky, just above the constellation of Scorpio which can be identified by the red star Antares.

The exact cause of a nova is still uncertain. Formerly it was thought that novae are due to the collision of two stars. However, several are detected each year. Most of them are visible only when brightest and when viewed with the largest telescopes. The stars are so sparsely distributed in space that collisions could not occur so often. Now it is supposed that there is some sort of an internal explosion that causes the flareup. After the rapid increase in brightness the star gradually dims and a few years later is continuing to shine as if nothing had happened.

ENERGY FROM COSMIC RAYS

COSMIC rays are the chief source of energy in the universe. From 30 to 300 times more energy is shooting through celestial space in the form of cosmic rays than in all other radiant energy forms combined. This is the conclusion of Drs. I. S. Bowen, Robert A. Millikan and H. V. Neher, of the California Institute of Technology, expressed in a communication to the *Physical Review*.

Their estimate of the energy falling on some body millions of light years away from the earth is based on new high-altitude measurements of cosmic ray intensities. They conclude that the energy falling on the earth from the stars is only twice as great as that coming from space in the form of cosmic rays.

The earth is located not far from a huge group of stars that astronomers call our galactic system so that the earth is in a region of highly energized space. A body located in inter-galactic space would receive from 60 to 600 times less starlight than the earth.

Measurements have been taken on the decrease in strength of the cosmic rays as these rays plow through the atmosphere. By adding up all the measured energies over all heights from the surface of the earth to the top of the atmosphere definite information has been obtained of the total cosmic ray energy intercepted by the earth.

The estimates of the density of starlight energy in the universe were made by Dr. S. A. Korff, also of the California Institute of Technology. The uncertainty as to the exact amount depends upon the uncertainty as to the exact number and brightness of all the stars and luminous matter in the universe.

THE WHITE PINE BLISTER RUST

"FOREST destruction as spectacular and ruthless as that caused by chestnut blight will begin in 1936 in the western pine forests of Idaho, Montana and Washington, except where white pine blister rust control is applied before that time."

With this prophecy S. B. Detwiler, of the U. S. Department of Agriculture, opens a survey of the white pine situation in the official publication of the Society of American Foresters. The rust invasion has reached the epidemic stage through this region.

White pine blister rust is a fungus disease of the highly valuable white pine species, which first invaded this country in the eastern states some years ago. It spends an essential part of its life cycle on gooseberry and currant bushes, so that if these shrubs are all destroyed in a given region, the white pines growing in the area will be saved. Blister rust control based on this principle has been successful in the parts of the eastern white pine area where it has been applied; but general economic conditions have prevented extensive use of the method in the larger white pine areas of the West. Since the U. S. Government still owns about a third of all the western white pine now standing, a large responsibility obviously rests with it.

Although the regular funds for the control of white pine blister rust, as provided heretofore through the Department of Agriculture, have been seriously curtailed through recent severe budgetary restrictions, it is expected that this loss will be more than offset by the use of the newly recruited "Forestry Army"; but this is an emergency measure only, and there is no definite long-time plan for carrying the fight into future years, which is indispensable if the western white pine forests are to be saved. Mr. Detwiler feels that this lack should be supplied at the earliest possible opportunity.

PROTECTION OF WHITE PELICANS

WHITE pelicans, among the most interesting of the water birds of western America, are in need of careful

scientific study and additional protection of their few remaining nesting grounds if the species is to be kept alive, according to a study just completed for the U. S. National Park Service by Ben H. Thompson.

There are still from 20,000 to 25,000 of these great birds in the United States, plus an unknown but probably smaller number in Canada. But their tenure of life is not so secure as their numbers might indicate. In the old days, before the West became so well settled, they had plenty of nesting grounds. Mr. Thompson's study of the record indicates something over seventy known locations of colonies scattered over the western parts of Canada and the United States in earlier times, whereas there are now only seven known large nesting colonies. Fortunately, five of these are in government-protected areas.

The principal menace to the white pelican is from the drainage of lakes where its nesting islands were located. Second to this has been the deliberate destruction of its nests or eggs by fishermen who disapprove of the bird's voracious appetite, though it has now been demonstrated that in most places pelicans make most of their meals off fish not good for sport or food.

Several years ago there was a brief period of artificial control of the pelican numbers on Molly Island in Yellowstone Lake, because of the pelican's rôle as carrier of a parasite of the trout. However, this policy has been given up and the Yellowstone pelicans now enjoy absolute protection by the National Park Service. No one is even allowed to land on Molly Island without written permission from the park administration.

ITEMS

BERYLS, which when clear are used as precious stones, contain different amounts of helium gas, according to the age of the rocks from which they have been obtained. This helium gas is derived from the transmutation of other elements which has been going on extremely slowly ever since the rocks were first formed. Therefore the amount of helium in a given mineral may give a clue to the age of the rock in which it is contained. Lord Rayleigh, the distinguished British physicist, reports in *Nature* that from his latest analyses of beryls containing helium gas, and from his experiments of the rate at which alpha particles or helium atoms are being produced from the element beryllium, it would take about fifty to a hundred billion years for the observed amounts of helium to accumulate in the mineral. This period of time is much longer than that estimated from the amount of lead derived from the transmutation of radioactive elements, in similar rocks, which never indicate an age of more than two billion years.

THE lowest temperature ever produced and measured by man, eighty-five thousandths of a degree on the absolute scale, has been achieved in the Kamerlingh Onnes Laboratory at the University of Leyden. This is extraordinarily close to the absolute zero point or minus 459.6 degrees on the Fahrenheit scale, at which all atomic motion would cease, electricity would flow without hindrance and other strange things would happen. The new greatest cold breaks records of about twenty-five hundredths of a degree which were made at both the University of California and the Leyden laboratory about two months ago. Professor W. J. de Haas, of Leyden, and Professor H. A. Kramers, of Utrecht, who made the experiments, used the method that is known as the "adiabatic demagnetization of paramagnetic salts." This takes advantage of the fact that when a substance is magnetized, it heats up. Using liquid helium made by cooling, liquefying, and solidifying of air, and then liquefying hydrogen to cool the helium, a substance is cooled as low as possible. Then it is magnetized. It heats up. Liquid helium is used to remove that heat. Then it is demagnetized taking care to keep it heat insulated. It becomes colder as a result of the demagnetization. Thus a lower temperature than ever before attained has been reached.

IT has long been known that many fishes have a chameleon-like ability to change color rapidly, by contracting or expanding their color-bodies; but Dr. Francis B. Sumner, of the Scripps Institution of Oceanography, has discovered that if their contact with a changed background is prolonged enough they will actually grow new color-bodies in considerable numbers, or get rid of part of those they have, according to the degree of darkness which it is necessary for them to match. How deeply this ability is inbred in the very nature of the fishes is demonstrated by the fact that very dark specimens, that have lived in black jars all their lives, will still respond fairly promptly and shed part of their complexions when transferred to white jars; while fishes kept from the day of their hatching in white jars will make the opposite change equally promptly if transferred to black-lined homes.

THE companion star to Sirius, the brightest star in the sky, has been found to be only one third as bright as previously thought. The trouble that arises from this dimness is explained by Dr. A. N. Vyssotsky, of the University of Virginia, in a communication to the current issue of the *Astrophysical Journal*. The size of a star is known from its brightness so the companion star must be much smaller than heretofore assumed. Thus bodies on its surface weigh less than before. The force of gravity on heavenly bodies is of interest for it is this force that produces the Einstein "red shift," which means that light coming from this star has had its frequency of vibration increased or its color reddened by a minute amount. The heavier the star, the redder the light. Values of this red shift obtained by Dr. Walter S. Adams at the Mount Wilson Observatory are greater than can be accounted for from Dr. Vyssotsky's observations. This discrepancy between theory and experiment will be checked by further observations on both the brightness and the reddening of the light. This little star has caused trouble in the past, for astronomers had to assume that it was made of something about four hundred times heavier than gold. The fact is partially overcome by Professor Vyssotsky's observations which indicate that it is about sixty times as heavy as the densest object on earth.

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SCIENCE NEWS

Science Service, Washington, D. C.

HEAVY WATER

JUST how much of the increased weight of "heavy" water is due to heavy-weight hydrogen and how much to heavy-weight oxygen has been shown by Professor Gilbert N. Lewis, of the University of California, in a communication to the *Journal* of the American Chemical Society.

All water molecules are composed of two atoms of hydrogen and one atom of oxygen, H_2O. But there are two kinds of atoms of hydrogen and three kinds of atoms of oxygen. The different atoms of any one element have different weights because their atomic hearts are different. The H may be either hydrogen isotope of mass one or hydrogen isotope of mass two and the two common types of oxygen are isotope of mass 16 and isotope of mass 18. Light water or nearly all pure ordinary water is made up of the lightest hydrogen isotope number one and the lightest oxygen isotope number sixteen.

Heavy water is made up of combinations of the heavy hydrogen and the heavy oxygen with the common lighter constituents. In a given sample of heavy water the amount of increased weight due to the strange hydrogen and the amount due to the heavy oxygen has never been known previously.

Professor Lewis took a sample of water from a still that concentrated heavy water and weighed it. He found that its density was 0.000182 in excess of light water. He saturated it with ammonia when the water was at 0 degrees Centigrade and then pumped off the ammonia when the water was at room temperature. By repeating this process he was able to remove 99 per cent. of the heavy-weight hydrogen. The remaining heavy water now had an excess density of 0.000085 so that the heaviness of the original sample was due to 0.000097 of heavy-weight hydrogen.

He then started again with another sample of the same heavy water and treated it with sulfur dioxide to remove the isotope of oxygen of mass 18. His measurements showed that of the original excess density at least 0.000073 was due to this oxygen.

Adding up the figures for hydrogen and oxygen, Professor Lewis accounted for 0.000170 of the original 0.000182. He states that an improvement of this simple experiment will provide an exact method for the analysis of water containing isotopes of both hydrogen and oxygen.

HEAVY WATER IN STAGNANT SEAS

THE new "heavy" water has been found in detectable quantities in the salt deposits at the bottom of extinct stagnant seas.

Dr. E. B. Washburn, chief chemist of the Bureau of Standards, has announced that the richest natural source of this peculiar type of water is to be found in native borax, a salt that exists in the beds of dead seas. The water of crystallization of this native borax contains seven parts of heavy water in every million parts of ordinary water.

Samples taken from the largest existing bodies of stagnant water, the Dead Sea in Asia Minor and the Great Salt Lake in Utah, when purified showed an increased weight over pure ordinary water. The Dead Sea water was heavier by two parts in a million and the Great Salt Lake sample was three parts in a million in excess of standard light water.

These natural sources of heavy water do not begin to compare in concentration with those prepared in the laboratory by Professor Gilbert N. Lewis, who has succeeded in preparing heavy water that is 35,000 parts per million heavier than ordinary water. Recently he has shown that pure heavy water will prevent the sprouting of tiny tobacco seeds and is determining now whether the seeds subjected to these tests were actually killed or only inhibited.

Dr. Washburn explained the presence of heavy water in stagnant seas as due to the faster evaporation of light water. The strange heavy component lags behind and in the course of thousands of years the remaining water becomes richer and richer in heavy water. The native borax that gave the highest concentration presumably came from a sea that was very old and had very few sources of fresh water.

Heavy water, like all water, has two atoms of hydrogen and one atom of oxygen. But either the hydrogen or the oxygen atoms, or both, in the heavy water have heavier hearts or nuclei than the common hydrogen or oxygen nuclei present in ordinary water. These rare types of hydrogen and oxygen are known as hydrogen isotope of mass two and oxygen isotopes of masses eighteen and seventeen. Part of the increased weight of the heavy water is due to the heavy hydrogen atoms and part is due to the heavy oxygen. The discovery of heavy hydrogen was made only two years ago by Professor H. C. Urey and Dr. G. M. Murphy, of Columbia University, and Dr. F. G. Brickwedde, of the U. S. Bureau of Standards.

PROFESSOR BORN'S RECONCILIATION OF OLD AND NEW PHYSICS

THE reconciliation between the new concepts of physics and the old classical views accomplished by Professor Max Born, of the University of Göttingen, is announced in his letter to the current issue of *Nature*, entitled: "Modified Field Equations with a Finite Radius of the Electron."

The letter reads as follows:

The attempts to combine Maxwell's equations with the quantum theory (Pauli, Heisenberg, Dirac) have not succeeded. One can see that the failure does not lie on the side of the quantum theory, but on the side of the field equations, which do not account for the existence of a radius of the electron (or its finite energy = mass).

I have developed a new method of the quantization of the electromagnetic field in such a way that the four independent variables (time-space) are treated absolutely symmetrically and the principle of relativity is trivially

fulfilled. From very general principles of quantum theory (superposition of states, linearity of the equations for the amplitudes of probability) one can deduce how Maxwell's equations have to be modified. In the classical theory, they are equivalent to the statement that the Lagrangian is given by: L is equal to one half of the quantity H squared minus E squared; in the new theory, this expression is replaced by a linear function of the field components, whose coefficients are non-commutative quantities of a type similar to those in Dirac's theory of the electron. In the limit, where the classical theory should hold, the new Lagrangian does not go over into the above given expression, but into: L is equal to one divided by "a" squared times the square root of the quantity (one plus "a" squared times the quantity H squared minus E squared) where "a" is a constant of the dimensions r sub-zero squared divided by e (e is equal to charge, r sub-zero is equal to radius of the electron), and only in the limit "a" approaching zero does this tend to the expression: one divided by "a" squared plus half the quantity H squared minus E squared.

Professor Born then gives an example of the simplest case of a symmetrical field independent of time and gives the differential equation of that field and the solution of this equation. These equations are omitted in this account of the letter because of the difficulty of translating them into terms other than mathematical nomenclature.

The letter to *Nature* is concluded with the statements: The form of the general expression for L guarantees the relativistic invariance. Thus there is no difficulty in calculating the properties of a moving electron on the basis of the classical theory. But the importance of the new Lagrangian L seems to lie in the possibility of a systematic quantization of the field.

PHOTOGRAPHIC PRINTS IN COLOR PROCESS

PHOTOGRAPHIC prints in color can now be made with but slightly more trouble than ordinary black and white pictures, according to those who have investigated a new German process, the invention of Dr. Bela Gaspar. Most color photographic processes hitherto have been limited to the production of lantern slides or transparencies which had to be examined in front of a bright light. With the Gasparcolor process, it is claimed, such a transparency, which can be made in a number of ways, can be used as a "negative," a piece of sensitive paper exposed behind it in the usual manner, the paper developed and fixed, and then converted to a color print by immersing in one additional bath. As many prints can be made as desired.

The emulsion of the sensitive paper is in three layers, instead of one, as in the common photographic paper. Each layer is so sensitized that it responds only to a certain group of colors. The top layer is sensitive to the blue, the middle to the yellow and green, and the bottom to the red end of the spectrum. Actually, Dr. Gaspar found that red light was absorbed by the two layers above it, but he overcame this difficulty by making the lower layer sensitive to infra-red rays, which are transmitted through them.

When the color transparency is placed in front of a sheet of the paper, and the whole exposed to light, each layer of the emulsion picks out part of the color, and then when it is developed each layer forms a record in clumps of silver, which is what makes up the blacks of the ordinary photograph, of the distribution of that particular color. In each layer is also a dye, which is bleached by the action of the silver. This bleaching is accomplished in the third bath, to which the print is subjected after fixing. The result is then a print in which the distribution of color corresponds with that in the transparency, which, in turn, reproduces the original subject with more or less fidelity. It is stated that the method can also be applied to film for making color motion pictures.

Many methods are available for making the transparency. In those like the autochrome or Agfa process, the plate is covered with microscopic colored granules, through which the emulsion is exposed. The part back of each granule is sensitive to that particular color. Instead of making a negative, then a print, the original plate is turned from a negative into a positive, and then the small colored granules make up a colored picture, in a manner similar to the small dots that make up a halftone picture as reproduced in a newspaper. The Finlay process is similar, but the screen is a separate unit, and is made up of small colored squares, instead of promiscuously placed granules. A plate is exposed behind one of these screens, developed, a print made on another plate, and another screen placed over the print on glass, thus making the picture in full color. Either method, as well as others, can be used with Gasparcolor paper, it is said.

THE OUTBREAK OF SLEEPING SICKNESS

THE present epidemic of sleeping sickness, encephalitis lethargica, raging in and around St. Louis is the worst in the history of the disease, according to information given to Science Service by the U. S. Public Health Service. Thus far the official record shows 129 cases and 12 deaths; and in previous outbreaks elsewhere not more than twenty or thirty cases have been reported in one place. The spread of the malady has been rapid, too: all the cases have been reported since the last day of July.

One thing which is puzzling public health officers is the curious distribution of cases in the present epidemic. Most of the cases and all but one of the deaths so far reported have been in the suburbs, with a total of some 200,000 population, while the city proper, with a population of about 800,000, has been much more lightly visited by the scourge.

Another unexplained feature is the high mortality among persons in middle life. Most of the deaths have been of persons between the mid-fifties and the mid-sixties.

The U. S. Public Health Service is cooperating actively with local health authorities. Dr. James P. Leake has been on the ground since the earlier stages of the epidemic, and Dr. Charles Armstrong joined him later. The Public Health Service has authorized the purchase of a supply of monkeys, which will be inoculated with virus obtained from the bodies of persons who have died of the disease, in an endeavor to obtain better scientific

knowledge of its nature and with the hope of eventually working out a method of prevention or cure.

As yet, the germ of sleeping sickness has not been found. It seems to be one of the filterable viruses—something apparently alive but too small to be seen with even the most powerful microscopes and able to pass through the pores of a fine porcelain filter which is able to stop all ordinary germs.

It appears to invade the human system through the nose, passing along the path of the olfactory nerves to the brain and thence down the spinal cord. If the resulting illness does not end in death it often leaves the victim mentally deranged.

The sleeping sickness of the temperate zone, encephalitis lethargica, is not to be confused with African sleeping sickness. The latter disease is caused by an animal germ that is quite visible under the microscope—a relatively large organism, in fact—and is transmitted from person to person by the bite of the tsetse fly.

THE DUTCH ELM DISEASE

DUTCH elm disease plays no favorites. Apparently no species of elm tree is immune to this deadly fungus, which is threatening the elms of America with the destruction that the chestnut blight visited on our native chestnut trees.

R. Kent Beattie, tree disease expert of the U. S. Department of Agriculture, who searched the Orient with good success for chestnut trees immune to the blight, holds out no such hope for elms to replace the American trees if the Dutch disease gets the better of the scientists and foresters who are at present fighting night and day to eliminate it from its foothold in New Jersey and the region around New York Harbor. All American species of elm on which the infection has been given a chance, whether by natural infection or deliberate experiment, have proved highly susceptible.

One species only, the Chinese elm, has an apparent immunity. But this immunity is only apparent, for when the tree is inoculated with the fungus it develops the characteristic brown markings in its young wood, although the leaves do not die and fall off as they do in other species. This permits the Chinese elm to harbor the disease and yet live; but it makes it a "carrier," just as there are human beings who harbor typhoid and other disease germs with no harm to themselves but with great danger to their neighbors. This tolerance on the part of the Chinese elm had led investigators to conjecture that the real home of the disease may be in the East. But this suggestion remains as yet only a suggestion: supporting evidence is still lacking.

One encouraging thing in the present situation, Mr. Beattie told Science Service, is the apparently restricted range of the present outbreak, serious as the trouble is within that range. Four trained scouts of the Department of Agriculture have within the past few days made a careful inspection trip for some distance into New England and up-state New York, and have found nothing to indicate the presence of Dutch elm disease in the territory they traversed.

Nevertheless, Mr. Beattie cautioned, every one who finds prematurely wilting, yellow or brown leaves on his trees, accompanied by brown streaks in the young wood, should regard these as dangerous symptoms. Samples of the wood should be sent to the nearest Dutch elm disease laboratory: in care of the Experiment Station, Wooster, Ohio, or in care of the Shade Tree Commission, City Hall, New Jersey.

ITEMS

THE white spot that now decorates the ringed planet Saturn is in reality the brightest of a row of spots strung over some forty degrees in longitude, or one ninth of the length of its equatorial belt, Professor Otto Struve, director of the Yerkes Observatory, has informed Harvard College Observatory. Professor G. Van Biesbroeck, using the 40-inch Yerkes telescope, observed the passage of the spot over the central meridian, and using earlier data given by U. S. Naval Observatory observers, has found that the period of rotation of Saturn is 10 hours 15 minutes, a value that compares favorably with past determinations.

LATE summer rains, coming after the middle of August, have helped the country's short corn crop a little in places, but in general the benefit is not great, J. B. Kincer, chief of the climate and crop-weather division of the U. S. Weather Bureau, has announced after a survey of recent weather conditions over the Corn Belt. "In Iowa, progress was fair in about half the state, but poor in several dry areas," Mr. Kincer stated. The bulk of the crop is advancing in maturity, he continued, with a small amount safe from frost as early as the end of the third week in August. Some corn is drying prematurely and will be chaffy.

MALARIA research in the largest swamp in the world, conducted by scientists of the Hebrew University in Jerusalem, has received support for another year from the League of Nations, it has just been learned. The swamp is known as the Huleh Swamp, and is the breeding place for clouds of mosquitoes that keep the native population in a state of constant re-infection. A recent visitor to the malaria stations of Palestine has been Dr. Yao, chief of the Malaria Division, Nanking, China.

THE thrilling but one-sided sport of pursuing game animals across the desert in motor cars has been prohibited by Signor Badoglio, Fascist governor of Tripoli. He has also put the more conventional sport of coursing with greyhounds under the ban, as well as the capture of game with nets. This is part of a comprehensive scheme of conservation now being fostered in Italy. In the mountains of the Abruzzi, brown bear, ibex and chamois are now given complete protection; in Sardinia the wild sheep, female deer and laemmergeier, a great bird of the vulture family, may not be hunted. Throughout Italy many small birds hitherto hunted freely are now tabu.

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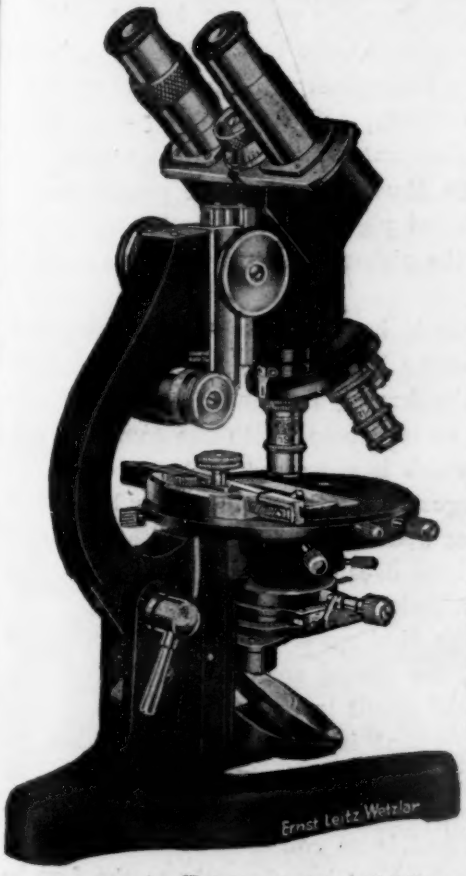

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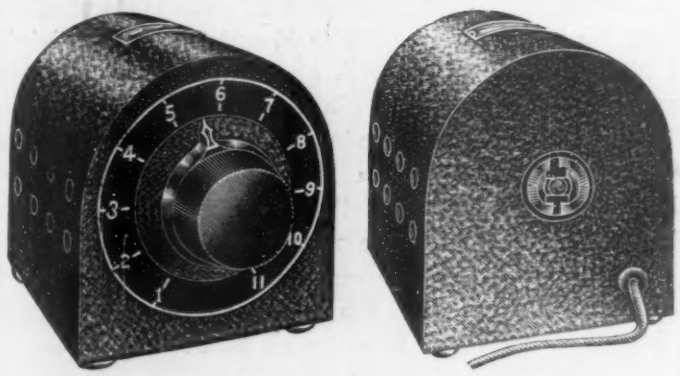

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SCIENCE NEWS

Science Service, Washington, D. C.

THE SECOND INTERNATIONAL POLAR YEAR

THE successful conclusion of the Second International Polar Year was celebrated at Washington on August 29 and at numerous other special observatories established a year ago, mostly in the north Polar regions, in a world-wide attempt to discover how the atmosphere as a whole circulates.

The Mount Washington Observatory, which, with the exception of the automatic station on Mount Wachusett, in Massachusetts, was the only weather station in the United States established for the Polar Year work, holds the distinction of being America's only high mountain meteorological station. It was established as a private venture under the direction of Joseph B. Dodge, Hut Manager of the Appalachian Mountain Club, and generously supported by contributions from scientific and other organizations, firms and individuals. The meteorological program was under the general supervision of the Blue Hill Meteorological Observatory, of Harvard University, which also participated in the Polar Year work in Milton, Massachusetts.

The regular observations and automatic records consisted of temperature, humidity, wind direction and velocity, and atmospheric pressure, also precipitation, cloudiness and intensity of sunshine and skyshine. A similar, but less ambitious, program was also carried out at the base of the mountain on both east and west sides, and, during the summer, at numerous other stations strung along the heights of the White Mountains in the vicinity of Mount Washington, with an additional base station ten miles to the west at Twin Mountain airport.

A special effort was made to obtain wind data from levels above the mountain top, which is at 6,293 feet above sea-level. Pilot balloons, small rubber spheres filled with hydrogen, were released in the rather infrequent intervals when the mountain peak was neither in the clouds nor the wind too strong to stand up against anything under 70 or 80 miles an hour! Since last October, when the station was established, 150 ascents were made.

Detailed observations were also made of cloud forms and motions at the different levels, adding greatly to the information yielded by the pilot balloons. Additional aerological observations were made when practicable throughout August by means of meteorological kites, flown by S. P. Fergusson from the top of the mountain, and airplane meteorograph equipment, loaned by the Massachusetts Institute of Technology, from Twin Mountain. These means brought down records of temperature, humidity and pressure to heights of nearly a mile above the top of the mountain. Pilot balloons released from Twin Mountain during the airplane flights provided data on the wind directions and velocities to even greater heights.

Mount Washington was one of ten special aurora observation stations through the northern United States, cooperating in a much more intensive program which was carried on in Arctic Canada and Alaska at the eight special Polar Year stations established there.

STUDY OF THE RELATIONSHIPS OF ANIMALS

USING centrifugal forces some four hundred thousand times the force of gravity to study the relationships of animals is the latest achievement of Dr. Theodore Svedberg, of the University of Upsala, Sweden. In a lecture at the Woods Hole Marine Biological Laboratory, he described the application of this method to studies of blood of various animals.

The carriers of oxygen in the blood are colored substances, called blood pigments. They are different in different animals, possessing differing molecular weights and structures. Therefore, if shaken up with a water solution they tend to fall to the bottom at different rates. To study these different rates at times short enough to be measurable it is necessary, however, to use forces that greatly exceed the force of gravity.

Dr. Svedberg has managed to produce this force by means of what is known as the ultra-centrifuge, a cell that holds the liquid to be tested, and is revolved at the terrific speed of 75,000 rotations per minute. To reduce friction it is necessary to have the entire rotating part of the apparatus in an atmosphere of pure nitrogen at a pressure only about one thirtieth that of the atmosphere. It is as though an automobile were to keep turning a corner at a speed of about three hundred miles an hour.

Pictures are taken through crystalline quartz windows as the centrifuge revolves, and these pictures are then run through an instrument which measures exactly the density of the image, thus giving a more precise knowledge of where the blood pigment being tested was in the cell at the moment the picture was taken than is possible to the eye.

From these studies it has been found that the blood pigments of some of the lower organisms are much more complex than man's, having molecular weights of the order of a million, as contrasted with the comparatively low one of 64,000 which is possessed by hemoglobin.

Dr. Svedberg suggests that the method may be used to tell different species apart in cases where the study of the form of the animal does not exactly place it in relation to the other animals of the same group.

Using a centrifuge that revolves at such high speeds is quite dangerous, for should some accident occur, the tremendous speed will result in an explosion.

Dr. Svedberg says that in the explosions he has experienced, the rotor has stayed inside the casing. This casing is made of special alloys, as are the other parts of the instrument, and is so constructed that the force of an explosion will be distributed partly to the foundation of the building.

Dr. Svedberg has carried back with him to Sweden for further study specimens of blood of several American marine animals.

HYDROGEN AND THE CORROSION OF METALS

HYDROGEN, the lightest gas known to man, is the sole defender against the ravages of corrosion. That hydrogen was the limiting factor in preventing wholesale corrosion of metals exposed to dampness was the opinion expressed by Professor Oliver P. Watts, of the University of Wisconsin, before a meeting of the Electrochemical Society in Chicago on September 7.

The slow but certain eating away of water pipes and minerals by salt and acid water is adding an enormous amount to the cost of modern civilization. Engineers are studying the theories of corrosion because it is only through a more complete understanding of the fundamental process that they will be able to diminish this loss.

Thirty years ago Dr. R. W. Whitney, now vice-president of the General Electric Company, announced that the corrosion of metals was an electrochemical process and this view is generally accepted to-day. When a metal is in contact with an acid solution corrosion takes place by the chemical process of the metal replacing the hydrogen in the acid. The acid dissolves the metal and hydrogen is released.

This released hydrogen coats the metal surface with an electrically charged layer that prevents the chemical reaction from continuing at the initial rate. If the hydrogen layer is built up to a sufficient thickness the reaction is practically stopped. However, under natural conditions, the hydrogen combines with the oxygen of the air to form water and the dissolving of the metal goes on at a rate that is limited by the amount of oxygen available to remove the protective coat of hydrogen.

Impure metals are corroded more quickly than pure metals. Electrochemists believe that this is due to the impurities taking up the hydrogen. Contrary to the popular belief that pure metals are subject to corrosion under the action of certain acid solutions, Professor Watts has shown that if oxygen is absolutely excluded copper will not corrode in a solution of sulfuric acid, a reaction that is very rapid in the open.

The survey of the electrochemical theory by Professor Watts was based on replies to queries to eleven investigators prominent in the field of corrosion in England and the United States.

OLD AGE

CULTIVATE your best abilities, practise the things in which you are most interested, if you wish a happy and contented and useful old age. This advice was proffered in an address by Professor W. R. Miles, psychologist of Yale University, at the Chicago meeting of the American Psychological Association.

Professor Miles has conducted an extensive survey of the skills, interests and mental attitudes toward life of 2,000 persons of all ages from 20 to 80, and on the data thus obtained he has based his conclusions.

Greatest energy and alertness, he found, are displayed by the youth of 20. At 30 a slight slowing down shows itself, but is more than made up by increases in confidence and skill.

The man of 40 is at a crucial crossroad. He can compensate for the more perceptible slowing down in his physical abilities by maintaining his still high manual skill, at the same time broadening his mental horizon by reading and mature conversation. If he does not do this, he will find himself slipping, and with no compensations he may at times put on desperate spurts to prove that he is "as good as he ever was"; with disastrous results when he fails, as he almost inevitably will.

As the decades pass and the man advances into middle age, the physical decline becomes more marked, but the mental compensations of the man who chose the wiser course at 40 continues to give an adequate offset. By now, if the man has chosen well, he has outside interests that takes his mind off the humdrum routine by which he earns his daily bread.

The more adequately prepared man of 70, and even of 80, does not need to fear the onset of genuine old age, with its great decline in physical power and even the troubles of ill health. If he has stocked his mind when he was in his mature years he can draw on this accumulated knowledge and experience and still play a satisfying rôle as counsellor to the new generation of young people.

Professor Miles' address, given under the auspices of Science Service, was sent out over the network of the Columbia Broadcasting System.

ITEMS

THE Lowell Observatory, at Flagstaff, Arizona, has notified the Harvard College Observatory that a new white spot has been observed on the ringed planet, Saturn, near its equator. It was seen on the planet central meridian at about midnight the night of August 28 and 29 and it was confirmed photographically.

OXYGEN needed by the roots of plants may be to some extent supplied by the plants themselves, from the oxygen generated as a by-product in the manufacture of food in the leaves. Evidence on this point has been obtained in experiments by Professor W. A. Cannon, of Stanford University, who has made preliminary reports to the Carnegie Institution of Washington and to the technical journal *Plant Physiology*. Professor Cannon set jars containing leafy shoots of willow and other plants in darkness and in light, and compared the rates at which their roots used up oxygen. He found in the larger number of cases that the illuminated shoots needed less oxygen from the outside, and therefore reached the tentative conclusion that the extra supply of the needed element was being provided for internally.

COMMON peat, which exists by the billions of tons in ancient bogs in this country, promises to become an important factor in the fertilizer industry, if researches conducted by Dr. R. O. E. Davis and Walter Scholl, of the U. S. Department of Agriculture, result in a practical manufacturing process for what they call ammoniated peat. The two chemists enclosed samples of peat in strong metal vessels along with ammonia synthesized out of the air and subjected the mixtures to high pressures and a considerable range of temperatures. The result was a fertilizer containing a high percentage of available nitrogen, the most expensive of the elements used in commercial fertilizers.

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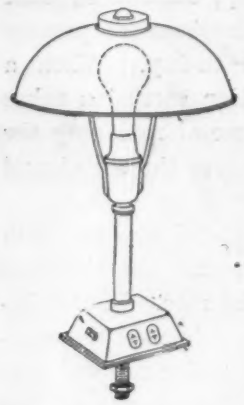

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SCIENCE NEWS

Science Service, Washington, D. C.

PAPERS READ AT THE CHICAGO MEETING OF THE AMERICAN CHEMICAL SOCIETY

EIGHTEEN different kinds of chemists, interested in everything from agriculture to water, gathered at Chicago on September 13 at a general meeting of the American Chemical Society, heard addresses on timely scientific subjects by four prominent American scientists. Furthest removed from the field of pure chemistry, but symbolic of the diversified interests of modern chemists, was the subject of "Cosmic Rays" discussed by Dr. W. F. G. Swann, director of the Bartol Research Foundation of the Franklin Institute. Dr. Swann reviewed the progress that has been made in the past year in determining the nature of this mysterious radiation that plows through celestial space to the earth. He concluded that the radiation consisted of high speed electrically charged particles and possibly bundles of very short wave-length light waves, called photons. Dr. C. E. K. Mees, director of the research laboratory of the Eastman Kodak Company, told of the advances that had been made in practical photography from studying and photographing the color picture or spectrum of the sun. The development of the "supersensitive panchromatic" films that are far more sensitive to visible light than the older types have allowed motion picture effects that were never dreamed of as being possible a few years ago. Infra-red or light waves of long wave-length invisible to the eye, having the remarkable property of penetrating atmospheric haze, have lent much to aerial photography. Dr. Francis C. Frary, director of research of the Aluminum Company of America, spoke on "Research in Metals and Alloys." He brought out the importance of minute quantities of foreign metals on the ultimate properties of alloys and discussed the technicalities of alloy testing and forging. "No longer," he stated, "can an inventor, working in a wood-shed, mixing metals by rule of thumb, hope to develop an alloy to meet modern requirements." In the field of pure organic chemistry and its application to industry, Dr. Charles R. Downs, chemical consultant of New York City, spoke on the American development of maleic acid and phthalic acid, which are widely used in synthetic resin and paint industries. One peculiar adaptation of these new products that was brought out by Dr. Downs was the use of succinic acid, a derived product. A six milligram tablet of succinchlorimide is sufficient to disinfect a canteen full of water in a few minutes.

THE expectation of life will be extended from seventy to seventy-seven years by the application of the chemistry of nutrition. Men will be at the height of their powers at sixty-five instead of fifty-eight. These are the beliefs of Professor H. C. Sherman, of Columbia University. Nutrition chemists are awakening to their duties towards human welfare and are concentrating their efforts around six "pillar concepts" enumerated by Professor Sherman as: "The quantitative studies of the energy relations, the protein chemistry of nutrition, the mineral elements, the vitamins, the inter-relationships between the different nutritional factors, and the principle that in the chemistry of nutrition the ultimate concern is essentially the nutritional reactions of the living body as a whole." Professor Sherman said that "while chemistry will not make blondes or brunettes, it will, by providing the suitable environment, make men and women more powerful constitutionally." Among the hopes held out for the future are: the age at which it is difficult to get new jobs in a field will be 52 instead of 45, age will yield less readily to youth, and newer generations will be taller and stronger than their parents. This last prediction is borne out by the fact that men and women at Harvard and Vassar are taller than their parents. This improved internal environment brought about by the application of the knowledge gained by nutritive chemists will pass on to succeeding generations, form a bulwark against disease, enlarge the prime of life, and postpone senility. The conclusions reached were based on experiments with more than 27 generations of rats. Popular belief attributes longevity to hereditary factors, but these experiments seem to establish very conclusively that it is greatly influenced by food.

DR. NICHOLAS D. CHERONIS, director of the Synthetical Laboratories of Chicago, told of his endeavors to find out the secret of the "marine fire" or "prepared fire" which twice wiped out besiegers' fleets and helped to defeat their armies on many occasions. "Marine fire" was the invention of an architect named Kallinikos, who came to Constantinople from either Syria or Egypt a short time before its first siege by the Arabs in the year 670. Swift boats armed with "siphons" to discharge his secret compound swept down upon the Arab galleys, and burned them to the water's edge. Again in 717 the Arabs came with a fleet and an army, and again the Greeks, using Kallinikos' fire, routed them utterly. The inventor's descendants, entrusted with his secret and guarding it jealously, manufactured the fire for the Emperors of Constantinople for many years, and it never failed to bring destruction and terror to the enemy. Some chemists have conjectured that it contained quicklime, which, when it touched the water, generated enough heat to set the compound afire. But Dr. Cheronis tried this, and also another chemical which had been suggested as the key to Kallinikos' secret, and found that combustion could not be started in that way. A more probable hypothesis, in his opinion, is that Kallinikos had discovered the possibilities of saltpeter, one of the ingredients of the later-invented gunpowder, and used it with the oils and resins to make his terrible flames. The "siphons" of the ships, he thinks, may have been the nozzles of pumps for discharging the liquid, which was then ignited by throwing a flaming dart or shooting a flaming arrow.

How modern chemistry has developed a commercial process producing a 300 per cent. increased yield in refined gasoline of higher quality as well as invading the manufactured gas and coal industries was told by Dr. Gustav Egloff, of the Universal Oil Products Company. The cracking process controls the number and quantity of the different products obtained by refining crude oil. When the process was put into commercial operation twenty years ago the gasoline it produced was considered to be inferior to the natural gasolines. In 1932, 43 per cent. of the gasoline sold was manufactured by this process and the motor fuel was recognized to have improved properties and anti-knock value. Savings of over $100,000,000 a year to the motorist and the conservation of 500,000,000 barrels of crude oil annually are the chief economic advantages to the public. The process has proved so successful in producing anti-knock gasolines for modern high compression motors that even natural gasolines are now processed. Cracking is not limited to gasoline production, Dr. Egloff emphasized, but is an important economic factor in the gas and coal industries, in the field of alcohol production, and in other industries. He pointed out that this process produces 250 billion cubic feet of high heating value gases annually, which are used to enrich gases of low heat content. A large proportion of these gases can be condensed and shipped in tank cars to small communities that do not maintain gas-making plants. As a fuel the supremacy of coal is being challenged by fuel oil. Dr. Egloff showed that the production of coal reached a peak in 1926 and then declined, whereas the fuel oil industry followed the general economic trend in 1929, when nearly 450,000,000 barrels were produced. Since 1913 the coal industry has declined 35 per cent. and the fuel oil industry has increased 150 per cent.

SYNTHETIC rubber made from chemicals is claimed to be superior to natural rubber for special purposes. Tests that showed its advantageous properties were described by E. R. Bridgewater, of E. I. du Pont de Nemours and Company. Although the synthetic rubber known as DuPrene is quite similar to natural rubber in its mechanical properties, it has entirely different chemical properties. This industrial rubber will resist swelling and dissolving in oils and greases. For example, ordinary soft rubber will dissolve completely when kept in hot crude oils for a week, whereas the synthetic rubber swells but does not lose its rubber-like properties. The deterioration of rubber on exposure to air and sunlight is less marked with DuPrene. It is vulcanized by heat alone without the addition of sulfur that sometimes proves objectionable in vulcanized natural rubber products. Automobile tires have not been made from the synthetic rubber, mainly because of its expense. It is used for special purposes such as: fabric belts, gasoline hoses, insulated wires, bottle stoppers, etc., that are exposed to oil, and conveyor belts that handle hot abrasive materials. Dr. Wallace H. Carothers, research chemist of the du Pont Company, concluded that the problem of synthetic rubbers is not solved completely as yet. The chemical mechanism underlying the synthetic manufacturing process is not clear, nor are the reasons for the physical properties of all rubbers. He expressed the opinion that a further study of the giant chemical molecules in rubber would make possible synthetic rubbers of still better properties, particularly in connection with highly specialized uses.

RUBBER from the only source within the borders of the United States, the guayule shrub, has been given a commercial test in automobile tires and tubes. What the motorist and the army could expect from tires that would have to be made from this local source in case of a war embargo was told by J. Harvey Doering, of the Firestone Tire and Rubber Company. The test tires built by this company from rubber that was exclusively guayule failed between 8,500 and 10,200 miles because of tread wear. The inner tubes proved satisfactory throughout the test. The chief difficulty with the extensive use of guayule rubber is its high resin content, Mr. Doering said. This can be overcome by an expensive process that will remove the resin. The tires tested were not made from treated rubber, but contained from 18 to 20 per cent. of resins. These rubbers are extremely soft and sticky so that it was found necessary to add several "drying" pigments before the tires could be built. Small quantities of dirt and bark in the rubber made it very difficult to build good tubes. Mr. Doering expressed the opinion that these foreign substances could be removed by some straining method, such as is used in cleaning reclaimed rubber. It seems very improbable that the guayule product will take the place of Hevea rubber imported from the East Indies except as an emergency measure, such as war.

A NEW process of soaking lumber in salt solutions to prevent shrinkage in dry weather that may eliminate the oven drying method was described by Dr. Alfred J. Stamm, chemist of the U. S. Forest Products Laboratory of Madison, Wisconsin. Lumber used in buildings must withstand changes in dampness from 30 to 80 per cent. humidity without appreciable change in shape. Wood treated with a definite amount of lithium chloride salt will not shrink until the relative humidity is less than 11 per cent., according to tests conducted by Dr. Stamm. This dryness is rarely attained under natural conditions. Although lithium chloride is the most effective agent in preventing shrinkage it leaves the wood wet and sticky so that it is useful only in special cases. Other salts show a smaller anti-shrink effect, but leave the lumber much drier and more adaptable to commercial use. Oven drying of green wood is equivalent to reducing the dampness from 100 per cent. to 0 per cent. humidity. This is unnecessary because lumber is never subjected later to such dryness. The new process depends on the salts binding the water in the wood and also an initial swelling effect.

METHODS of removing fluorine, the cause of unsightly mottled teeth, from water supplies, were reported by Dr. C. S. Boruff, research chemist of the State Water Survey of Illinois. Although several methods have been discovered, Dr. Boruff hesitated to recommend any one

method before further research work is done. All but one of the processes investigated are fairly expensive and troublesome. Only one or two parts per million of fluorides in drinking water are now known to cause mottled teeth. This dental decay is a very disfiguring condition consisting of dark and almost black discoloration over the upper front teeth. Every tooth in the head is affected and the injury, consisting of imperfect calcification of the enamel, is permanent. The purification of the water supply would not be expected to cure the existing cases of this dental decay and the success of any change would not be apparent for six or seven years, when the teeth formed subsequent to the water change would be appearing in children's mouths. Two cities, Bauxite, Arkansas, and Oakley, Idaho, have discarded former water supplies in favor of others containing less fluorides. Dr. Boruff stated that some cities, especially in the southwestern part of the United States, may not be able to find suitable alternate supplies and will be forced to attempt purification. The difficulty inherent in the removal of this very soluble and injurious ion are made apparent by the fact that from 8 to 16 pounds of fluorides to a million gallons of water are sufficient to cause mottled teeth.

BLAME for hay fever may be pinned on the proteins in the sneeze-producing pollens, rather than on their sugary or starch constituents. This was indicated by a paper presented by Dr. Marjorie B. Moore, of the Abbott Laboratories, and Dr. Leon Unger, of Northwestern University Medical School. There has been some division of opinion in scientific circles over the ultimate cause of hay fever. Some investigators have held that it is due to pollen proteins, while others have been of the opinion that certain sugar- or starch-like bodies, called polysaccharides, are to blame. Drs. Moore and Unger exposed hay-fever-causing pollens to the action of pepsin, which digested away most of the protein in them, leaving the polysaccharides unchanged. The pollens thus treated lost much of their mischief-raising power. The case against the pollen proteins is thereby strengthened and the polysaccharides exonerated of the suspicions which had been raised against them.

"LOST time," which amounts to 250,000,000 days annually in the United States, can be reduced by a proper diet for workers, according to a report made by Dr. Arthur D. Holmes and collaborators. Their experiments, which were carried on for three years, showed that very fat or very thin persons are likely to be absent from their work through illness more than similar workers of nearly average weight. This absenteeism increases the cost of all manufactured goods by interrupting production schedules. They state: "Our studies, carried out along sound research lines, have indicated that the addition of cod-liver oil to the usual home diet is a valuable aid for reducing such absenteeism. Comparing the amount of absence due to two groups of industrial workers, it was found that the men and women who received cod-liver oil were absent 1.1 per cent. of their working hours, whereas control subjects working in the same rooms with the cod-liver oil subjects were absent 3.1 per cent. of the time." Considering their results on the basis of the weight of the subjects they conclude that employment managers of industrial concerns should give preference to prospective employees whose body weight was not far from the average for his or her height and age.

CHEMICALS undergoing bombardment by hearts of helium atoms which are thrown out by the explosion of radioactive substances, are changed in many strange ways. Water is formed from hydrogen and oxygen at all temperatures from the super-freezing cold of 180 degrees below zero to the enormous heat of 500 degrees Centigrade. This is just one of the hundred or more reactions that have been forced to occur by subjecting the constituent atoms to the destructive forces of the radioactive projectiles called alpha particles by Professor Samuel C. Lind, of the University of Minnesota. He found that these same reactions between gases could be made to occur by passing an electrical discharge through them. Both the alpha particles and the electrical spark knocked off some of the outer negatively charged electrons of the atoms, leaving positive electrically charged clustering points to serve as centers for the gathering and combination of atoms. Professor Lind considers that the evidence which has so far been gathered is not sufficient to determine exactly the mechanism of the chemical reaction.

THE architecture of simple chemical molecules can be determined to within one-100,000,000th of an inch by means of x-rays. X-rays accomplish this feat by being shot through a small container filled with vaporized chemical compounds where they are bent by the parts of the molecule and so form a pattern when they fall on a photographic plate. Professor Willis C. Pierce, of the University of Chicago, told how these patterns could be interpreted to give the distances between the atoms and the arrangement of the atoms in benzene molecules. This extension of the use of x-rays was perfected recently by Professor Peter Debye, of Leipzig, Germany. The mechanism of the process is very similar to the older method of determining the position of atoms in crystals. The molecules in the gas are so far apart that they do not have a combined effect of bending the x-rays and so the pattern is due to the arrangement of atoms within each separate molecule. Professor Pierce found that the carbon atoms in a benzene molecule were arranged in a flat hexagonal ring with other atoms lying outside the ring and in its plane.

EXAMINING scraps of mortar and stucco from old Greek fountain houses, pebble pavements and tombs, found by Dr. T. Leslie Shear, of Princeton University, a Princeton chemist reports that mortars used then were about like modern mixtures. The specimens contain on the average about 25 per cent. of sand and 36 per cent. of lime. Mr. Foster said that his analyses disagree with the record left by Vitruvius, an architect who lived in Augustus' reign. Roman glass of the second century A. D., also tested chemically, proves to be of the soda-lime type, somewhat similar to modern window glass.

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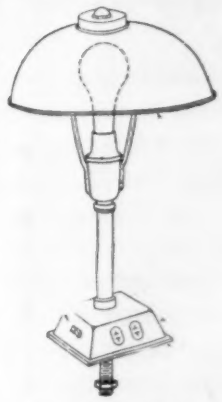

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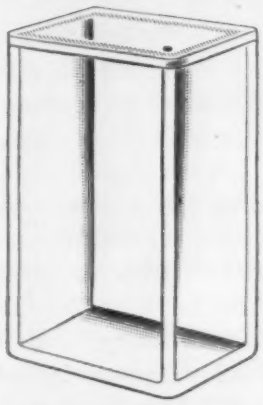

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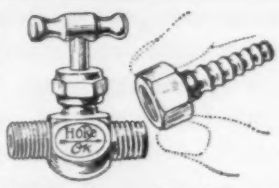

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SCIENCE NEWS

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ADVANCES IN THE APPLICATIONS OF CHEMISTRY

CHEMICAL curiosities that have recently become useful in scores of jobs from speeding up the aging of wine to protecting life from poison gas, a method of warding off colds and strengthening the body against other ailments, new resins that make textiles non-creasable and are strong enough to be moulded into chairs and window frames: these developments were among the advances reported to the Chicago meeting of the American Chemical Society.

Describing as "utopian and distinctly American achievements" the working out of processes by which ordinary air is made to combine with benzene and naphthalene to produce cheaply and in abundance maleic acid, a laboratory rarity a short time ago, Dr. Charles R. Downs, chemical engineer, of New York City, pictured some of the many uses to which this new industrial substance is already being put.

"It usually requires several years of aging for the precipitation of the excess tartar in wine," Dr. Downs said. "If the wine is bottled before the precipitation of tartrates is completed, it will lose commercial value because some tartrates will precipitate as undesirable. If, however, calcium malate is added to wine, even when young, any proportion of tartaric acid can be removed in a very short time. The acid is also used as a gas mask ingredient for absorbing ammonia vapors."

Maleic acid and related compounds have also been found to prevent the development of rancidity in stored fats and oils, serve successfully as new resins for lacquers and varnishes, aid the dyeing of textiles, replace advantageously acids commonly used in tanning, become a baking powder ingredient, aid the substitution of a chemically known salt for ordinary table salt for those who can not tolerate table salt, and in the form of little tablets conveniently disinfect small quantities of water for drinking purposes through the release of free chlorine.

Carotene, the vitamin A carrying yellow coloring matter of carrot, butter, whole milk and other fruits and vegetables, is much more valuable than nutritionists now believe and its use in the diet should be increased, according to Dr. A. F. O. Germann, of Cleveland. He said that prehistoric man was able to resist many diseases that afflict civilized men because he ate quantities of this substance.

Citing recent recognized research, Dr. Germann said that "a carotene supplement to the normal diet is the best known preventive of upper respiratory infections; brings about improvement in vision in human cataract; gives promise of relief in certain allergic conditions such as house dust allergy and hay fever; causes more rapid healing of wounds, and gives promise of greatly improving the general health and well-being."

Dr. Carleton Ellis, of Montclair, New Jersey, described unusual uses for the newest syntheic resins, the molded products which first replaced celluloid and hard rubber articles, but are now finding a much wider field of application. Tanks nine feet in diameter have been made from one new material of the phenol-aldehyde class. It is now possible to mold articles as large as chair backs and legs, table tops and radio cabinets.

Moldings made from urea and formaldehyde, Dr. Ellis continued, are strong, light in color and very resistant to darkening under influence of light. Articles can be made from them in a great variety of bright colors. When textiles impregnated with these resins are heated, the resins set and the cloth becomes non-creasable.

"PANTOTHENIC" ACID AS STIMULUS TO GROWTH

ALL life may involve the presence of a powerful growth-stimulating acid which has been found in many different kinds of plants and animals and has been concentrated by Dr. Roger J. Williams and Carl M. Lyman, of Oregon State College, to a potency one thousand times stronger than any previously reached.

Because of the wide-spread occurrence of this little-known substance Dr. Williams, who reported his latest researches to the American Chemical Society, has tentatively named it "pantothenic" acid from the Greek for "from everywhere." The name is justified by tests which show that pantothenic acid was obtained from all sources examined so far which include: cattle, human and chicken liver, milk, crab eggs, sea-urchin eggs, planarian worms, earthworms, oysters, bacteria, molds, yeast, mushrooms, potatoes, apples, grains, algae and soil.

Dr. Williams stated that "It is probably safe to say that this acid is more widely distributed in nature than any other physiologically potent substance. The evidence shows that it is contained in all living substances from the highest mammalian form down to the lowliest worm and from the highly developed green plant down to the tiniest yeast, mold or bacteria. The acid was discovered because of its effect on yeast growth. When placed in a solution in which yeast is growing it may increase the rate of multiplication from ten to twenty thousand fold in eighteen hours. The fact that it is apparently present in all living cells suggests that it may act as a growth regulator in all cells. It is interesting to observe that yeast and mushrooms, which proverbially grow rapidly, are comparatively very rich sources of the acid."

As recently concentrated by Dr. Williams and his associate, pantothenic acid is so potent in speeding up the growth of yeast that a quantity much smaller than the head of a pin has a detectable effect when placed in 250 gallons of solution in which yeast is growing. The presence of one part of the preparation in one billion parts of yeast culture medium is noticed by the resulting growth increase. Dr. Williams points out that while the origin of this acid in nature is obscure, except for the fact that it is produced by certain molds in soils, for

example, we are led to suspect that it is one of the unidentified water-soluble vitamins. In fact, several of its properties at first suggested a close relationship to vitamin G; yet, unlike the widely known vitamins, it appears to be a substance that even plants can not make for themselves, but must obtain directly from the soil.

Dr. Williams' present work grew out of studies of the many practically unknown substances that stimulate yeast growth and carries on a detailed examination of one of the more simple of these materials. It is the acid constituent, he found, of the previously widely heralded "bios," a hypothetical substance thought necessary to life. Though the chemical formula of pantothenic acid has not been determined, something is known concerning the structure of its molecule. Its molecular weight has been found to be about 150.

WATER FILMS STUDIED BY ELECTRIC "FEELER"

SEEKING from the infinitesimal building blocks of matter themselves the secret of why atoms and molecules cling together, to compose the living and lifeless substances of the world, Dr. William D. Harkins and E. K. Fischer, of the University of Chicago, reported to the American Chemical Society that they are now able to reveal the presence of thin layers of organic material five hundred times too small to be seen through the most powerful microscope.

Though we can not see them, such films are on all surfaces, Dr. Harkins explained, and knowledge of them will lead to a better understanding of why all things hold together. He pointed out that since the human body is made up largely of surfaces in contact with surfaces, this research may eventually explain body processes now little understood.

Films of water have been studied. Such films, only one ten millionth of an inch in thickness, are divided up into islands and continents, and the study of the geography of the surface of almost any body of water reveals an interesting topography. The continents and islands, too small to be seen, are located by measuring with very delicate and sensitive instruments changes in electrical potential caused by the film.

Dr. Harkins has found that the outer part or top of an organic film is, in general, electrically positive with respect to the underlying liquid. Although the change of potential, usually about three tenths of a volt, seems small, such potentials are related to important features of the surface. Paradoxically, films composed of extremely large molecules, with weights of about 17,000, set up the same potentials caused by films of smaller molecules. What is even more strange, very large molecules gave much thinner films than those made up of molecules sixty times smaller.

ELECTRIC CURRENT FROM ELECTROSTATIC MACHINES

ENORMOUS disks, spinning at high speed in an almost perfect vacuum, will replace the familiar generators and motors of modern electrical plants, according to Dr. R. J. Van de Graaff, physicist of the Massachusetts Institute of Technology, who spoke before the Leicester meeting of the British Association for the Advancement of Science.

These disks would be great electrostatic machines, producing direct current electricity at tremendously high voltage. The vacuum would be necessary in order to prevent the production of tremendous sparks that might wreck the whole machine and would in any case prevent the electricity from being led out on wires to be usefully employed. Dr. Van de Graaff believes that vacua sufficiently high to insulate the machines against such electrical breakdown can be produced, even in the large housings that would be required for the industrial production of current by electrostatic machines. He exhibited designs for such machinery.

If Dr. Van de Graaff's prophecy is realized, it will be, in a sense, progress made by setting the clock back. For the electrical machines that were used by the eighteenth-century school of "natural philosophers," of which our own Dr. Benjamin Franklin was a brilliant member, were all of the electrostatic type. They generated electricity by friction on large disks. Instruments of the same kind are still used for special purposes in laboratories.

The trouble with such machines has always been that the air was not a sufficient insulator to prevent sparks after a certain potential had been built up. For this reason the development of the electric age had to await the discovery that electricity could be generated in another way, by the moving of a conductor in the field of a magnet. All our present generators are elaborate arrangements of magnets, past which systems of wire coils are rapidly moved, with arrangements for capturing and leading off the current thus produced. They are the best we have; but their working efficiency is admittedly not as high as could be attained, at least in theory, by properly arranged and insulated electrostatic machines. Dr. Van de Graaff believes that such theoretically possible machines can actually be built.

Dr. Van de Graaff has attracted much attention among physicists by the simple but tremendously powerful electrostatic machines he has already built, first at Princeton and latterly at the Massachusetts Institute of Technology. These have produced "artificial lightning" measured in hundreds of thousands of volts, used in atom-smashing experiments.

ANTARCTIC METEOROLOGY

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AT the airport weather station at South Washington, Virginia, a veteran weather man of the first Byrd Antarctic Expedition is making ready to join Admiral Byrd again for a renewed investigation of South Polar weather.

While he talks to aviators of such matters as ordinary United States weather, William C. Haines is looking ahead to September 25 when he will sail from Boston on Admiral Byrd's ship to study the icy, blizzardy weather of the world's coldest continent.

The whole Antarctic, as big as the United States and Mexico put together, turns out just one commodity that the world takes and uses. That is weather. South Amer-

ica and lands farther from the South Pole get some of their waves of chill, drought, heat and rain from the busy South Pole weather factory. But the rules of production and distribution that run the factory are almost unknown.

To investigate, to get at some of the reasons, this is the task confronting Mr. Haines and the other meteorological staff member of the expedition, George Grimminger. It is Mr. Grimminger's first venture into the Antarctic. Both men are from the U. S. Weather Bureau.

It is expected that one base for observations may be established in the interior, at an advanced position, perhaps not far distant from the Pole. Some of the weather records noted by Mr. Haines on his previous year in the Antarctic may be far eclipsed. His coldest weather record was 72 degrees below zero, and the warmest summer day was just three degrees above freezing. In the midwinter blizzard, in July, his instruments recorded a drop to 58 below zero and just when the cold was most intense the wind blew 43 miles an hour. And that, Mr. Haines thinks, may be a record for blizzards anywhere.

"We expect to lay stress this year on upper air observations," Mr. Haines reported to Science Service. "We can generalize more accurately about the wind direction and velocity as we find it high in the air. At ground level, weather records are more complicated by influences of local geography."

Winds are especially important in the Antarctic weather, Mr. Haines explained, for winds, even more than icebergs, are carriers of cold there. Swiftly changing temperatures and changes in air density raise the wind, and the wind carries cold across the icy continent and out toward warmer latitudes.

Instruments packed for the expedition's use will include standard equipment, furnished by the U. S. Weather Bureau, for measuring temperature, barometric pressure, wind direction and velocity, and humidity. The clocks have to be adjusted for low temperature, but not much trouble is expected in handling equipment. On the previous expedition, the non-freezing ink in the pens of self-recording instruments froze at 60 below zero, until alcohol and glycerine were added.

Mr. Haines believes that the possibility of establishing permanent weather stations in the Antarctic, to keep the world informed and warned of weather brewing there, seems very remote these days. So expensive is such a proposition that it can only be carried out if the leading countries of the world cooperate in the financing. Meanwhile, the data that will be needed are being gathered by the weather explorers, and it is hoped that even without Antarctic weather bureaus the world may profit by greater knowledge of Antarctic weather.

ITEMS

A SABER-TOOTH cat species, much smaller than the great tiger-sized animals made famous by the California tar-pit finds, is represented by a jaw fragment from Idaho described in the current *Journal of Mammalogy* by Dr. C. Lewis Gazin, of the U. S. National Museum. Another new species of extinct cat found in the same region resembles the modern puma or mountain lion. These fossils were found among a mass of bones of extinct species of horses collected by paleontologists of the museum. The stratum in which the find was made is of Pliocene Age, perhaps two or three million years old, and dating before the coming of the great glaciers that once covered most of this continent.

PETRIFIED FOREST NATIONAL MONUMENT, in eastern Arizona, one day may be the great show place for antelope in this country, if plans now being considered by the Office of National Parks, Buildings and Reservations of the Department of the Interior are carried out. The Petrified Forest is a natural range for these plains animals. At present about 38 antelope range immediately south of the monument and along the approach road, while another band of 30 ranges immediately southeast of the monument and still a third, numbering about 200, ranges to the west. With this nucleus in the vicinity of the monument, there is sufficient stock available for further development.

STARCHED clothes wash more easily than unstarched clothes. Chemists have devised a machine that will tell how much dirt is left in a piece of cloth after washing. Exact measurements on washed cotton fabrics with various kinds of starch are described by Professor Lawrence E. Stout, of Washington University. Professor Stout's measurements gave a scientific proof of the correctness of the old saying that every woman knows, "Starched clothes wash easier."

CYSTINE, a sulfur-containing organic compound, is deficient in the fingernails of persons suffering from arthritis, often known as "rheumatism of the joints," according to a paper by Dr. M. X. Sullivan and Dr. W. C. Hess, of Georgetown University. The two research men tried injecting colloidal sulfur into the blood-stream of six arthritis patients. They found that the cystine in their subjects' fingernails returned to normal, and at the same time the symptoms of arthritis abated. Drs. Sullivan and Hess are now working on the problem of the relation of certain microorganisms to arthritis. They state that the lowering of the cystine content of body tissues implies the presence of injurious substances resulting from the activity of such microbes.

HYDROCYANIC acid, deadliest of all simple chemical compounds, is formed in the caps of two species of mushroom, it has been discovered by M. Mirande. The poison was found in the gills of a small mushroom belonging to the genus Marasmius; it is extractable in cold water from both fresh and dried material, though neither the spores nor the underground root-like threads of the mushroom contain it. The second hydrocyanic-acid yielding mushroom belongs to the genus Clitocybe; the poisonous night-shining American species known as the "jack-o'-lantern mushroom" is also a member of this group. This mushroom, unlike the Marasmius species, gives up its poison only when heated.

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X-RAYS IN MEDICINE

THE vital part played by x-rays in guarding and improving the health of the people was described by Surgeon General Hugh S. Cumming, of the U. S. Public Health Service, at the opening meeting of the American Congress of Radiology in Chicago on September 25.

"To no branch of medicine does the public health of the nation owe more than to radiology," according to Dr. Cumming. "In fighting cancer and tuberculosis, in protecting industrial workers from the dangers to their lungs and health of certain industrial dusts, in giving accurate diagnoses of tumors of the brain, the x-rays have played a leading part. Upon radiology, perhaps, more than any other single science except surgery, we depend for aggressive and defensive measures against cancer. In connection with the fight on tuberculosis, I know of nothing more valuable than the diagnostic and prognostic means thus placed at the disposal of the specialist.

"In connection with the study of industrial diseases the Public Health Service has for several years investigated the kinds of dust in quarries, mines and grinding establishments. We have found that the best defense against 'dusting' the lungs and respiratory tracts of the workmen in such occupations to a point that is dangerous to their health is periodic examinations of them by the use of the x-ray. Thus we become able to exclude from such occupations those individuals who are most susceptible to the dusting process.

"Another contribution of the Public Health Service came about through the efforts of Dr. Liberson, a roentgenologist serving the three New York Marine Hospitals. Dr. Liberson was first to perfect a method for use in diagnosing tumors of the brain and since his findings 248 operations for encephalography have been performed in these hospitals without a single mortality."

Dr. Cumming paid tribute to the pioneers in radiology who often suffered and died in their efforts to give mankind the benefits of x-rays and radium. "An ardent group of devoted workers have in slightly over thirty years developed a toy into a machine, wonderful in construction, precise in operation, awe inspiring in its effects," he said. "The x-ray embodies the accumulated ideas, the best thought, fearless enterprise and untiring devotion of a large number of physicians, technicians and other scientific men and women. In this great American congress are the men who have raised this wonder child from infancy to helpful manhood. In a single generation we have seen this miracle develop before our eyes."

Dr. Cumming also pointed out that the U. S. Bureau of Standards played an important part in bringing about an international standardization of therapeutic "dosage" of x-rays, and that the bureau, represented at the congress by Dr. Lauriston S. Taylor, head of its x-ray laboratories, has rendered valuable service to manufacturers in standardizing x-ray equipment.

BIRTHMARKS TREATED BY RADIUM

MOLES, birthmarks and similar masses which are known to physicians under the name of nevi may for the most part be safely and permanently removed by radium treatment, it appears from the experience of Dr. William S. Newcomet, Philadelphia radiologist. Dr. Newcomet reported to the American Congress of Radiology the results he had obtained in treating such cases during the last fifteen years.

"There is a well-grounded idea existing among the laity that to treat a nevus is to invite malignancy," said Dr. Newcomet. "Yet it is a well-established fact that many cases of malignancy start from nevi. Unfortunately, even with the publicity that has been given to this subject, there still remains, among a certain class, a constant fear that it is dangerous to remove nevi."

Dr. Newcomet prefers radium to x-rays for treating these cases on account of the susceptibility of the surrounding parts of the body and also because it is easier to confine the effects of radium to a more limited area. In fact, he stated that these marks should always be irradiated with radium, never with x-rays. Occasionally the radium treatment must be followed by surgery to remove scars in the case of very large marks. Sometimes, when the patient has been treated in childhood, some slight deformity has resulted in adult life from lack of development of the affected part or because some of the natural tissues were replaced by the tumor mass. These cases are comparatively rare.

In the majority of cases results of treatment were very satisfactory. The marks or tumor masses had disappeared; the site was practically normal and without scar. No other method could accomplish so much and, while the treatment is not so rapid as some other method, the results are better.

These lesions are not dangerous to life, therefore there is no justification for the employment of any dangerous procedure. In conclusion the fact is stressed that in all cases the mild application of radium may bring about a diminution of the tumor mass and it should always be used previous to operation. Even in severe cases the reduction of the tumor mass will materially reduce the operative risk.

MILD ATTACK OF ENCEPHALITIS

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THE first case of encephalitis in one of the investigators fighting the epidemic in St. Louis appears to have been suffered by Dr. J. P. Leake, U. S. Public Health Service officer in charge of the investigations.

This attack was not incurred as a result of the experiment in which three of the scientists submitted to bites from mosquitoes that had previously fed on encephalitis patients. It is too early for results from this experiment, planned to determine whether mosquitoes do carry the disease, as has been suspected from the fact that they transmit a similar disease of horses.

Dr. Leake himself pooh-poohs the idea that he had an attack, but his associates are convinced that he did. The attack occurred early this month while he was on his way to Washington from St. Louis, to report on the situation to Surgeon General Hugh S. Cumming. The attack was very mild, lasting about one day.

There have been many such attacks during this present epidemic. In fact, the men investigating the outbreak believe that there have been hundreds of such cases that have not been reported, simply because they were so mild that the sufferer did not realize himself that he had anything serious ailing him and failed to consult a physician. In these cases, the attack consists of intense headache, nausea and vomiting. The patient feels very ill for several hours, but by the end of a day has recovered.

This very mild type of case, among other things, has convinced the investigators that the disease which has been epidemic in St. Louis is not typical encephalitis as previously known, and they are now calling it encephalitis B. Further indication that this is a new form of the disease is seen in the fact that there are absolutely no after-effects, which have been a serious feature of ordinary encephalitis. The patients who do not die in this epidemic recover entirely.

The names of the scientists who volunteered for encephalitis-infected mosquito bites have been withheld by the U. S. Public Health Service. This sort of service is considered merely part of the day's work by officers of the service.

Meanwhile encouraging results are being obtained from the efforts to establish the disease in monkeys. If this can be done the need for human guinea-pigs will have been eliminated. Symptoms of the disease are now appearing in the second group of monkeys, inoculated with material from a group that developed the disease after inoculation from encephalitis patients.

PENETRATION OF COSMIC RAYS

COSMIC rays from celestial space that are four times as penetrating as those known before have been shown to exist. They can plow through half a mile of water without being completely absorbed.

Professor W. Kolhörster, working in the cosmic ray laboratory of the Magnetic Meteorological Observatory in Potsdam, and at great depths below the earth in the salt mines at Strassfurt, has obtained evidence for these ultra-penetrating rays. Bombs filled with gas at high pressures served as the cosmic ray meters. Half a mile of water or its equivalent thickness of earth was necessary to cut out these high frequency rays, Professor Kolhörster reports in a communication in a recent issue of *Nature*.

Besides their great penetrating abilities these new rays have the property of maintaining the enormous negative electric charge of the earth which has been puzzling scientists for many years. The earth is charged with negative electricity to a voltage so high that it fairly bristles with the charge. The Department of Terrestrial Magnetism states that in order to maintain this charge a positive electric current of 1,500 amperes must be flowing continuously away from the earth. Something must maintain this negative charge and Professor Kolhörster believes that the new hard cosmic rays can do this.

American physicists, principally at the California Institute of Technology and at the Bartol Research Foundation, have found that the most penetrating cosmic rays yet observed here could not serve to keep the earth negatively charged, but would tend to discharge it. Experiments at Mexico City have shown definitely that the previously known cosmic rays were made up of both positively and negatively charged particles but that there were more positive than negative particles. These would dissipate the earth's negative charge.

NEUTRONS MADE BY HIGH VOLTAGE

ARTIFICIALLY produced neutrons, made in the Norman Bridge Laboratory of Physics by the use of high voltage rather than radium, may prove to be more effective in splitting the hearts of atoms than anything previously known.

In the brief time that neutrons have been known, they have proved particularly useful for atom smashing. It does not seem to matter how much energy they have. They slip into atomic hearts or nuclei and make trouble that gives physicists important information on the composition of matter. Neutrons are released from atomic hearts by artificially speeded helium ions corresponding to radium-emitted alpha particles but with lower energy.

Several months ago H. R. Crane, a graduate student, Dr. C. C. Lauritsen and Dr. A. Soltan, an international research fellow from Poland, working with the large x-ray tube at the California Institute of Technology, found that artificially speeded helium hearts could be used in producing neutrons. At that time they did not formally publish their results as they desired to perform checking experiments. A report has now been made to *The Physical Review*.

Helium atom hearts are speeded with a potential of a million volts, the limit of the present tube. These slow helium ions are ten thousand times less efficient than alpha particles in producing neutrons. They are, however, so much more numerous in the electrical apparatus that more neutrons can be produced in this way than from any radium source at present available anywhere. In fact, slow neutrons such as those artificially induced by the Pasadena experimenters can not be obtained in appreciable numbers from any radioactive source.

INFLATION AND DEFLATION OF THE UNIVERSE

THE universe is periodically expanding and contracting and we are living at a time when an expanding period is nearly finished and a contracting period is about to begin. This is an alternative theory of the expanding universe pointed out by Dr. Janet H. Clark, associate professor in physiology in the School of Hygiene and Public Health of the Johns Hopkins University, in a communication to *Nature*.

Dr. Clark bases her argument on the fact that the nebulae furthest removed from the earth appear to be receding at the greatest rate and the five nearest neighbors are not receding but are approaching the earth.

The farthest nebulae, so far removed that it takes 150,000,000 years for their light to reach the earth, appear to be speeding away from us at the enormous rate of about 15,000 miles per second. That is what they were doing in the dim past when the light signals now received by astronomers were sent out by them. What they are doing now is a mystery that will not be solved for another 150,000,000 years. The nebulae that are only 3,000,000 light years away have a more modern history. They are only receding at about 350 miles per second.

This variable recession of the outermost nebulae and the approach of the five nearest neighbors of the earth suggested to Dr. Clark that the universe is periodically expanding and contracting. Because astronomers can not "see" all the parts at the same time they can not determine the speed of the various parts at any one instant. It may be that only time and many millions of years of observations on the nebular velocities will solve this problem and settle this theory.

Astronomers compute the velocity of the stars from color pictures or spectra of their emitted light. If the spectral lines are shifted to the red the star is moving away from the observer and the amount of this shift is a direct measure of the velocity of recession. Since the majority of the nebulae exhibit this "red shift" the theory of the expanding universe was propounded.

Sir Arthur S. Eddington, professor of astronomy at the University of Cambridge, England, comments on Dr. Clark's theory in another communication to *Nature*. He welcomes an alternative theory of the expansion of the universe and adds some criticisms of the new theory.

ITEMS

TAKING advantage of the fact that dismantled warships can be obtained for practically nothing, M. Georges Claude, well-known French chemist and inventor, has decided to try at his own expense a new and unusual method of obtaining power to run an ice-making plant, using for the purpose the temperature difference between surface and deep sea-water. Using the Claude-Roucherot process, which was given a trial some years ago in Cuba, it should be possible to utilize economically a temperature difference of only 10 degrees Centigrade. A 10,000-ton ship, the *Tunisie*, is now being reconditioned at Dunkerque, and transformed into a floating ice-manufacturing plant. It is expected that the work will be completed in ten months.

DEATHS are now recorded for the first time in the whole United States. With the admission of the State of Texas to the U. S. death registration area, just announced by Secretary of Commerce Roper, the Census Bureau is able for the first time to compute reliably the death rate for the entire nation. The cause of every death in the United States will now be a matter of record, as will also the age, sex, occupation and nativity of the dead person. When the Census Bureau first began to gather vital statistics for the nation, in 1902, only ten states and the District of Columbia were included in the death registration area. Gradually other states have been added. But six states have been admitted only in the last six years. Texas is still not included in the area of registration of births. It is hoped that this will be attained during the coming month, however, thus making Uncle Sam's vital statistics 100 per cent. complete so far as area is concerned.

THE bite of a little red simulid fly has brought blindness to some 45,000 Indians in Chiapas and 5,000 in Oaxaca, according to the Mexican Health Department. The life history of the parasite which the fly deposits in the blood of man is now known, but no good remedy to combat it has been worked out. Because the Oaxaca region is small, Health Department brigades have chosen it as a field of experiment. The larvae of the flies are found among dead leaves along creek and river banks, and by cleaning these and burning the débris some impression has been made on the blindness epidemic. Tumors appear on the heads of those affected, and these are being operated on by the wholesale by the sanitary brigades. This eventually cures the individual if the disease has not gone too far. The tumors are filled with long, thin, coiling organisms that can be seen by the microscope. Being phototropic, or light-loving, these make their way to the eye. Indians with affected eyes are almost blind in the sun, but see better at night.

ULTRA-VIOLET light is being used in Winnipeg, Manitoba, to detect ringworm carriers in the cat population. If Kitty or Tom is carrying the disease, the infected hairs will emit a brilliant greenish light when ultra-violet rays filtered through Wood's glass strike them. The test will disclose the presence of the fungus that causes the disease, even in apparently healthy cats. The importance of determining such carriers is illustrated by a case reported to the Canadian Medical Association by Drs. A. M. Davidson and P. H. Gregory, of the University of Manitoba. A little boy developed ringworm about three weeks after being given an apparently healthy kitten for a pet. The ultra-violet light test showed the kitten to be infected, although other tests had failed to do so. Microscopic examination of the fluorescent hairs confirmed the presence of the fungus. Drs. Davidson and Gregory believe it very probable that the boy was infected by the kitten. Since similar cases may frequently occur, they suggest using the ultra-violet light test on kittens before giving them to children as pets, in order to prevent the disease in the young masters.

SCREW worm flies, long a major cattle pest in southwestern states, have staged a severe outbreak in Florida and Georgia, which has caused a good deal of alarm among cattle raisers in the Southeast. Entomologists of the U. S. Department of Agriculture, however, do not feel that this invasion is permanent. They credit it to the abnormal weather in that section during the present summer. The screw worm fly normally lays its eggs in the carcasses of dead animals or slaughter-house offal, but when these are not available in sufficient numbers it will deposit them in the bodies of living cattle, taking advantage of new brand marks, chance wounds, or tick and insect bite punctures. The larvae or "worms" invade the tissues, causing much discomfort and pain, and sometimes death.

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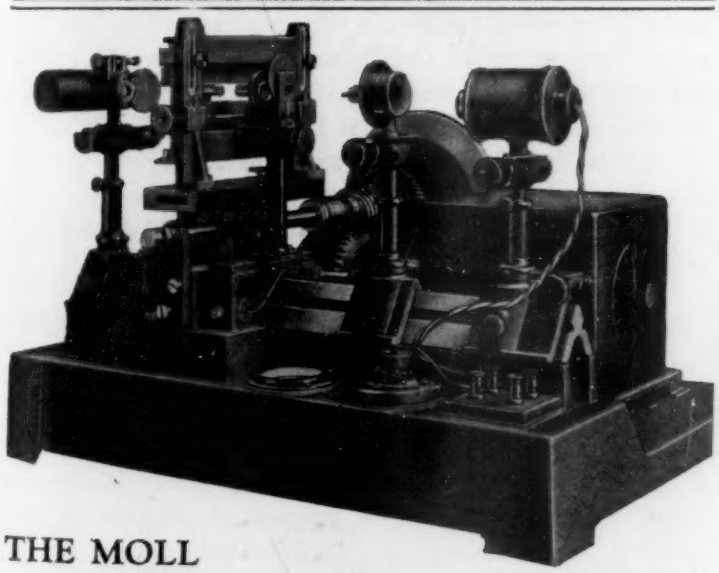

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SCIENCE NEWS

Science Service, Washington, D. C.

DEUTONS CREATING NEUTRONS AS CAUSE OF ATOMIC DISINTEGRATION

Two particles recently discovered by science, the neutron and the deuton, promise to play an important rôle in atomic disintegration as the result of experiments just made at the California Institute of Technology, Pasadena, California.

Radium has been definitely superseded as the most effective generator of neutrons, those neutral particles which, since the discovery of their existence two years ago, have assumed an increasingly important place in experimental physics. Two weeks ago H. R. Crane, a graduate student, Dr. C. C. Lauritsen, and Dr. A. Soltan, an international research fellow from Poland, using the large million-volt x-ray tube developed by Dr. Lauritsen, showed that the hearts of helium atoms or helium ions could be speeded up sufficiently to knock neutrons out of beryllium atoms. In this way they produced twice as many neutrons as any radioactive source ever did.

Now they have tried deutons, the hearts of the double weight hydrogen atoms, as the projectiles flung by high voltage at various substances. They were astonished to find that deutons used instead of helium hearts release from beryllium five hundred times as many neutrons as ever before obtained.

Deuton is the name given to the nucleus of the hydrogen isotope of mass two. The heavy weight water was sent to Pasadena by Professor G. N. Lewis, of the University of California, to see whether the Pasadena workers could cause their deutons to shatter themselves against heavy atoms. They do not. But when propelled against the light beryllium atom they penetrate the nucleus and apparently turn it into boron. In its exuberance the newly born boron nucleus kicks out a neutron with ten million volts energy. Elated over their results, the physicists tried the deutons on lithium. It yielded neutrons even more copiously than beryllium. Helium is the by-product in this case.

With such powerful means of producing neutrons of varying energy it will be easy to disintegrate atoms in relatively large numbers. The neutron is the ideal tool for this purpose. It insinuates itself into any nucleus with great ease and then splits it open. The contriving physicist watches this process and gains knowledge therefrom.

NO PROOF THAT MOSQUITOES TRANSMIT SLEEPING SICKNESS

ENCEPHALITIS, popularly known as sleeping sickness, probably is not transmitted by mosquitoes or other insects, in the opinion of Surgeon-General Hugh S. Cumming, of the U. S. Public Health Service. "The disease is more likely transmitted in some other way, probably in the same way that influenza and infantile paralysis are conveyed from person to person," said Dr. Cumming upon his return to Washington from his second visit to St. Louis, center of the encephalitis epidemic.

So far, none of the U. S. Public Health Service officers, who let themselves be bitten by mosquitoes that had fed on encephalitis patients, have developed the disease. It is now ten days since the experiment was started, and sufficient time has elapsed for the disease to show itself in these men. However, while the mosquito transmission theory has not yet been proved, it has also not yet been entirely disproved.

Mosquitoes were suspected in the St. Louis epidemic partly because of work done by U. S. Army officers indicating that mosquitoes transmitted a similar disease in horses and partly because of the peculiar geographical situation in St. Louis, Dr. Cumming explained. The city has not enlarged its boundary line for over a generation. As a result there is a large population living in many small communities in St. Louis County which are not legally part of the city.

The communities have no organized system of sewage disposal, each community dumping its sewage into the many small rivers that drain the area. During the past summer there was a drought, with the result that the rivers were half dried up and mosquitoes bred in unusually large numbers and there was a great deal of malaria. The combination of greatly increased numbers of mosquitoes with the fact that there were more cases of encephalitis in the county than the city suggested that mosquitoes might be responsible for the outbreak.

Real progress in the fight against the disease can be made if attempts to isolate the causative virus are successful, according to Dr. Cumming. This would enable the investigators to find out more about how the virus grows and, possibly, how it is transmitted. Experiments along this line with monkeys are encouraging. Although the virus itself has not yet been isolated, there are indications that the disease has been transmitted to the animals, which is the first step.

THE PLAGUE OUTBREAK IN MANCHURIA

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THE present outbreak of plague reported from Manchuria was foreseen by Dr. Wu Lien-teh, director of the Chinese National Quarantine Service. This is the impression gained by trained quarantine workers in this country from reading Dr. Wu's latest annual report, published in the spring of the current year.

In his official document, Dr. Wu, who has an international reputation in connection with plague prevention work, deprecates the emasculation of the Manchurian Plague Prevention Service as a result of the Japanese military occupation of the northern provinces.

According to latest consular report received by the U. S. Public Health Service from Tsien-tsien, bubonic plague is raging in the Taonan and Nungan districts, while the Tunchowliao district is suffering a visitation of pneumonic plague, the most dangerous form of the disease.

Dr. Wu was director of the Manchurian Plague Ser-

vice which was established after the terrible epidemic of pneumonic plague in Manchuria and North China in 1910 and 1911. This epidemic took a toll of 60,000 lives and the monetary loss was estimated at $100,000,000.

In 1920–21, pneumonic plague again was epidemic in Manchuria, having entered China from its haunts in Transbaikalia. By this time the Plague Prevention Hospital and Institute were operating at Harbin and were the means of checking the epidemic at that point and preventing its further spread, in Dr. Wu's opinion.

However, since the Japanese occupation, the activities at Harbin of the Plague Prevention Service have been "practically strangled," and the Plague Prevention Hospital is in charge of only a junior officer. The inference is, plainly, that the present plague outbreak is a direct result. Meanwhile, the activities of the Plague Prevention Service have been resumed at Shanghai for the territory within the Wall of China.

Health officials hesitate to forecast how far the present outbreak will spread. Plague is a winter disease in Manchuria. The fact that it has become epidemic this early in the year suggests that it will be wide-spread. Until it reaches the seaports, Darien in particular, no concern need be felt over likelihood of its spread to the Philippines or continental United States. Quarantine officers in Washington are sure that the Japanese will lose no time in fighting the epidemic if it reaches the occupied territory. So far it has always been north and west of Manchukuo.

In contrast to the Chinese situation, plague seems to be on the decline in other parts of the world. The Health Section of the League of Nations reports that during the last two years plague has disappeared from Algeria, Tunis, Tripolitania and Nigeria. There has been a marked decline in Egypt and East Africa, and in Senegal it is limited to Dakar. On the other hand, the disease has invaded fresh territory in South-West Africa and Angola and has increased in Madagascar.

Plague has been very rare in Europe. No cases of human plague have been reported in Central and North America during the past two years. In South America the disease is on the decline in Ecuador and Peru, but fresh small foci have appeared in Bolivia and Argentina. In Iraq the disease has been localized in Bagdad. There has been a very noticeable decrease in northern India and limitation of plague to a principal focus situated in the west of the Deccan. In the Netherlands East Indies the disease has spread to the mountainous area in the west, but declined in the center and east. In China, reports previous to the present outbreak showed revivals of endemic foci on the borders of Inner Mongolia.

RUBBER MEMBRANE FOR THE TELEPHONE

A NEW rubber compound which will withstand moisture for many years under the most adverse weather conditions has been developed by research chemists working in the Bell Telephone Laboratories. The rubber is to be used to prevent the ready entrance of moisture into telephone transmitters installed in exposed locations and will improve reception in markets, taxi stations, police boxes and harbor craft.

To keep moisture away from the thin aluminum diaphragm of the transmitter, a rubber membrane is interposed between the diaphragm and the mouthpiece. Such a membrane must be extremely thin and supple and it has been found can not be thicker than about three thousandths of an inch. Rubber as thin as this has been commercially used for a long time, but its life at best has been from one to two years. The new rubber compound, tests have shown, does not deteriorate when placed for varying periods of time in a vessel of pure oxygen at a pressure of 300 pounds per square inch and a temperature of 158 degrees Fahrenheit.

When subjected to this test, poorly compounded rubber usually loses shape and deteriorates in less than one day.

Following the development of the rubber, engineers were called to invent a contrivance to mold the compound in the necessary thinness and shape. A highly polished steel mold is now used. The mold is shaped to the dimensions of the desired part, with allowance for the slight contraction which takes place in soft rubber when it cools to room temperature. A quantity of the plastic compound is inserted in the mold cavity, which is subjected to a pressure of several tons per square inch by a hydraulic press. Steam at 20 pounds per square inch is circulated about the mold. Under the pressure and heat the compound takes shape and becomes ready for assembly.

Used along with waterproof cord, the new compound has been installed and found successful aboard the U. S. S. *Lexington* and *Saratoga* in withstanding the effects of salt water.

THE PEKING MAN'S BRAIN

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PEKING man had a brain distinctly human in type, showing a notable advance in development over the brain of Pithecanthropus, the Java man discovered over forty years ago by Dr. Eugene Dubois. But the one brain cast it has been possible to make thus far indicates that the first-found Peking skull belonged to a young man with a small head.

"The adolescent Sinanthropus is a human male, belonging to the Neanderthal group of mankind, the species *Homo neandertalensis*, maybe an interesting new race, with individually imperfectly developed and hence abnormally small brain," according to Dr. Dubois.

Dr. Dubois presented his conclusions to the Royal Academy of Sciences in Amsterdam, after he had made a long and careful comparative study of brain casts made in the Peking man and Java man skulls.

The total volume of the brain cast received by Dr. Dubois from Dr. Davidson Black, first student and describer of Peking man, was 918 cubic centimeters. This is approximately the same size as the brain cast of Java man.

In shape and anatomical development, the Peking man's brain cast resembled the Neanderthaler's—and even modern man's—much more than it did the brain cast of Java man. Most notable was the relatively high-arched

front portion, as compared with the almost flat-fronted brain of the Java man. This arching of the front part of the brain is considered one of the most distinctly human characters found in brain architecture.

This presented a poser: here was a brain almost as small as that of the very primitive Java man, but showing the same basic form as that of advanced human species. But Dr. Dubois points out that the brains of modern "microcephals" show exactly the same peculiarity: they are subnormal in size but quite normal in general shape and structure. Hence he suggests that this particular individual Peking man was an ancient "microcephal." He found further support for his opinion in certain peculiarities in the bones of the skull itself, which have their counterparts in the skulls of modern "microcephals."

The skull which yielded this interesting brain cast was that of a young male individual, perhaps fifteen or sixteen years old. It was most nearly whole when found, so that it was possible to prepare the cast with relatively little loss of time.

The second Peking man skull, which appears to be that of a woman, was broken into many fragments, so that before a cast can be made in its brain-cavity it will be necessary to piece it together—a tedious and time-consuming task. It may be several years before the second brain cast will be ready for study.

The development of the speech-center area of Peking man's brain led both Dr. Dubois and Dr. Black to the conclusion that this race was capable of articulate speech. Remains in the cave where the skulls were found indicate that Peking man knew the use of fire and that he could make at least crude implements of stone.

INDIVIDUAL OCCUPATIONAL ABILITIES

THE analysis of individual occupational abilities through a testing service was urged as an important part of any program for the new federal-state employment service being created under the Wagner-Peyser Act, in a report just issued by the Employment Stabilization Research Institute of the University of Minnesota. The report was prepared by Drs. John G. Darley, Donald G. Paterson and I. Emerick Peterson.

The proposed testing division in the public employment service can easily become the center of occupational analysis and guidance for the community, it was pointed out in the report. It can become the focal point for individuals who need guideposts to economic stability and occupational adjustment.

"The past few years have shown the bewildering lack of such guideposts," the report went on. "The two years of the Minnesota project, out of which the testing division has grown, have proved that individuals need to be directed to economic stability through occupational analysis and individual planning.

"Unemployment is a sore spot in the social economic order that harbors it; but in all probabilities, unemployment in greater or lesser degree will characterize the industrial system of this country for many years to come."

A program of individual analysis and planning will not eliminate unemployment. Nevertheless, it does hold out hope for a better utilization of existing knowledge of human engineering in preventing unnecessary human waste.

"The Occupational Testing Division as an integral unit in the new type of public employment office, will approach the goal of a healthy occupational system, through a study of the individual's adjustments to the problem confronting him in economic competition. In the evolution of this work, traditional notions of vocational fitness will give way to an understanding of the measurable, human capacities and interests that underlie job success. Aimless job hunting will tend to disappear in the face of occupational analysis and guidance and centralized clearance of employment opportunities."

ITEMS

ELECTRICITY was used to treat disease as early as the third century before Christ, Dr. Leo Pariseau, radiologist of Montreal, told members of the American Congress of Radiology meeting in Chicago on September 25. He traced the history of the therapeutic use of electricity from this early time down to the Century of Progress through statements in 100 famous old books from his own collection. First mention of this use of electricity was found in Aristotle's "De Natura." The electricity came from the torpedo fish whose live body was said to possess qualities of healing pain. From Aristotle down to the sixteenth century various writers told of the same fish, identified as the "electric ray." The word electricity, however, was not used until William Gilbert, physician to Queen Elizabeth, coined it.

CANCEROUS diseases are now being fought with continuous low-voltage doses of x-rays over the entire body as well as with 700,000 volt dosages for short periods. The comparatively new method of continuous irradiation was reported by Drs. Lloyd F. Craver and William S. MacComb, of Memorial Hospital, to the Congress of Radiology. Patients being treated by this new method, called the Heublein method because it was first put into operation at Memorial Hospital by the late Arthur C. Heublein, lie in one of four beds in a specially constructed ward. For as long as 20 hours out of every 24, x-rays are sent into their bodies from a low voltage machine near the ceiling of the room. This is continued for a period varying from several days to three weeks.

"VERY high-voltage x-rays will prove to be of great value in cancer therapy," stated Dr. G. Failla, of New York City, at the meeting of the American Congress of Radiology. Dr. Failla described recent tests made at Memorial Hospital which showed that 700,000 volt x-rays are superior to 200,000 volt x-rays in treating internal cancer, and that radium is still better. Because of the expense, the full value of radium, however, can not be realized in practise. A method of expressing radium dosage in roentgens, the international unit of x-radiation, was also reported by Dr. Failla. The dose just large enough to produce reddening of the skin with a large beam of gamma rays from radium is 1,500 roentgens as compared to 540 roentgens required to produce the same degree of reddening with filtered 200,000 volt x-rays.

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SCIENCE NEWS

Science Service, Washington, D. C.

BACTERIOPHAGE SAID TO ACT BY PRODUCING ANTITOXINS

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BACTERIOPHAGE, popularly known as the "germ-eater," cures disease not by "eating" or dissolving the causative bacteria but by producing antitoxins in the body. The famous bacteria-dissolving power is merely a side-issue, apparently of no importance in curing or preventing disease, as has long been suspected by some investigators.

This explanation of how the potent but mysterious phage acts to cure or to prevent disease was given by Dr. N. W. Larkum, of the Michigan Department of Health, at the Indianapolis meeting of the American Public Health Association. Dr. Larkum reported studies supporting this theory.

When Dr. F. d'Herelle, formerly of the Pasteur Institute and Yale University, announced his discovery of bacteriophage, it gave rise to great hopes that here at last was a way to wipe out disease. All that would be necessary to stop an epidemic of cholera, for instance, would be to pour a tube of the proper bacteriophage into the drinking water supply. These hopes were not entirely fulfilled, but results were sufficiently good to encourage a number of physicians in continuing to use the phage and to investigate its mode of action. Among them has been Dr. Larkum.

If it is true, as he now strongly suspects, that all bacteriophages are capable of producing antitoxins, scientists now have the means to fight specifically most, if not all, known diseases caused by bacteria. This may be done from the preventive standpoint, by immunizing well persons with bacteriophage; or sick persons may be treated by injecting serums prepared by immunizing animals with bacteriophage.

Dr. Larkum pointed out that in most, if not all, infectious diseases, the serious illness is caused not by the bacteria themselves but by the toxins or poisons they produce in the body. Bacterial or infectious diseases have only been successfully treated when soluble toxins could be obtained from the organisms causing the disease and antitoxins developed.

For example, success in the treatment of diphtheria followed the development of diphtheria antitoxin. Prevention of this disease now is possible by injecting substances known as toxin-antitoxin or toxoid. These stimulate the body to produce enough antitoxin of its own to neutralize the poison from any diphtheria germs that invade it.

The effect of bacteriophage when used to treat disease suggested that this was also the way it acted. When typhoid bacteriophage was injected into typhoid fever patients, it was particularly noticed that the symptoms of poisoning subsided. The bacteria did not disappear any sooner than usual, but the patients were not sick.

Earlier investigators, among them Dr. d'Herelle, considered this possibility but their studies led them to believe that bacteriophage did not produce antitoxin. Dr. Larkum and his associate, Ruth Corpron, however, conducted experiments with exactly opposite results. Their work showed that bacteriophage is not a toxin, is not itself an antitoxin, but produces or stimulates the production of antitoxin in the body.

RABBIT TICK AND ROCKY MOUNTAIN SPOTTED FEVER

A RABBIT tick with the impressive name of *Haemaphysalis leporis-palustris* may be the mysterious agent that has spread the deadly Rocky Mountain spotted fever from its original haunts in the Bitterroot Valley of Montana to the Pacific and Atlantic coasts of this country. This new explanation for the recent spread of this highly fatal disease was suggested by Dr. R. R. Parker, of the U. S. Public Health Service, at the meeting of the American Public Health Association on October 9. He is in charge of the spotted fever investigations of the federal health service at Hamilton, Montana, where serum for protection against this disease is manufactured.

Dr. Parker also pointed out the effects of meteorological conditions and changing agricultural practises on the prevalence of the disease. For instance, in the Snake River Valley sheep raising was the only form of agriculture for many years. Men engaged in this occupation are particularly exposed to bites of the Rocky Mountain wood tick that carries the disease, and there was a high percentage of cases among these sheepherders. Now sheep raising has been almost crowded out by more intensive forms of agriculture, such as dry land wheat raising, which are less favorable to spotted fever, and a much smaller number of cases are being reported.

Irrigation and the gradual grubbing out of the sage brush and intensive cultivation of the land have created conditions less and less favorable for ticks, and cases of the disease are now infrequent in this valley. One physician who used to treat between 35 and 50 cases a year now sees only from one to three cases in a year. In addition, vaccination of the sheepherders and local campaigns against the rodents that harbor the ticks are reducing the number of cases.

The rabbit tick which Dr. Parker suspects of being a factor in spreading the disease across the country does not bite man, as do the Rocky Mountain wood tick and the dog tick, which transmit the disease in the East. However, the infection, kept alive by the rabbit tick with the long name, may be picked up by other rabbit ticks that do bite man. Dr. Parker has found the virus of the disease consistently in the particular rabbit tick he suspects, and he pointed out that this tick is wide-spread in the United States and other parts of North America, whereas the Rocky Mountain wood tick does not range far from its mountain habitat.

The disease was presumably prevalent in the Rocky Mountain region long before this part of the United States was settled. It was not commonly recognized until the late 90's. It is now found in all the Pacific Coast states and all the Rocky Mountain states; in parts of Minnesota, Iowa, North and South Dakota, Nebraska,

Tennessee, Louisiana, possibly in Missouri, in Alabama, Oklahoma, Arkansas, the District of Columbia, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, North and South Carolina and Indiana. This wide distribution of the disease has been of great concern to health officers, particularly since they have not yet been able to find the way in which the disease has been spread.

STANDARDIZATION OF TESTS FOR GERMS CAUSING FOOD TO SPOIL

TESTS for germs or bacteria that cause foods to spoil need to be standardized, members of the American Public Health Association were told by Lawrence H. James, of the Bureau of Chemistry and Soils, U. S. Department of Agriculture. Mr. James termed such standardization a "present necessity." It will aid in the better protection of the health of the consuming public. It will also pave the way for the development of new and improved methods of food preservation. "The quality and safety of many foods depend upon the control of spoilage bacteria, yeasts and molds," he said.

At present, different laboratories use different methods for detecting these organisms. No detailed directions, simplified and standardized for general use, are available. Every state in the union conducts some type of official food analysis and practically all cities of metropolitan size, with populations of 500,000 and over, maintain food analytical laboratories. In addition, many college, university and consulting laboratories are called upon to make analyses in which they have had but little experience either with the food products or with the special methods required. The whole situation will be simplified and many more laboratories will be able to make the necessary tests, if accepted directions are made available in printed form, it was pointed out.

Mr. James reported that a committee of the American Public Health Association, of which he is chairman, has secured the official cooperation of that organization, of the Society of American Bacteriologists and of the Association of Official Agricultural Chemists in organizing a group of experts on food bacteria to develop standard procedures for the microbial analysis of foods.

LOWER ANIMALS KILLED BY "HEAVY WATER"

HEAVY water, containing the recently discovered double weight hydrogen, kills tadpoles, guppy fish and worms. Professor W. W. Swingle, of Princeton, using some of the rare heavy water manufactured by Princeton chemists, has found that the extraordinary H_2O, with 92 per cent. of its hydrogen atoms consisting of the isotope mass two (deuterium), is lethal to certain fresh-water animals.

Green frog tadpoles survived only an hour when placed in the heavy water. Tadpoles of the same sort immersed in distilled water that contained only 30 per cent. heavy water, were unaffected by a 24-hour treatment. Paramecia, one-celled organisms that are favorite biology experimental material, resisted the heavy water successfully for an equal period.

Relatively large quantities of heavy water are now being produced in the Frick Chemical Laboratory at Princeton University by Professor Hugh S. Taylor and Dr. Henry Eyring and Arthur A. Frost. A cubic centimeter, approximately a thimbleful, of the heavy water is produced every two days. This unusual supply is allowing its use in various untried experiments. Professor Earle E. Caley has demonstrated that it has a smaller capacity for the dissolving of salts than ordinary water. Tests are now being made to ascertain its effect upon acids.

Physicists studying the structure of the atom will find the heavy water of great use, because most of its hydrogen atoms are twice the ordinary hydrogen mass. Experiments have shown that in attempts to break down the atom by collision with electrically propelled hydrogen projectiles, much smaller voltages are required when heavy water is used.

Professor Taylor explained that there is one part of heavy water in every 5,000 parts of ordinary Princeton rain-water. Twelve hundred gallons of ordinary water are treated in order to produce three ounces of heavy water. The new substance has become one of the most valuable known in the commercial field. A price of $150 is asked for a gram. At this rate a teaspoonful is worth nearly $600 and a quart $150,000. Princeton now has on hand about a glassful and is about to raise its production to a thimbleful a day.

What effect the drinking of heavy water will have on animals and human beings is not yet known, but it is believed that it may bring on a fever, and therefore might be useful in diseases that are treated by raising body temperatures.

GRASSHOPPERS IN 1933

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GRASSHOPPER depredations in the United States during the past summer were the worst for many years, according to a statement made by Dr. W. H. Larrimer, of the Bureau of Entomology, U. S. Department of Agriculture, in an interview with Science Service. Although the early hatching from their eggs in the soil was slowed down by wet, cold spring weather, subsequent heat and drought operated to the advantage of the 'hoppers, and the damage they caused in late summer more than made up for their delayed start. Even into early October they were reported as still going strong in the Northern Plains states.

Egg-laying for 1933 was finished in August, Dr. Larrimer stated, and preliminary cursory examinations give every indication that 1934 will again be an exceedingly bad grasshopper year, unless unpredictable climatic factors come to the rescue of the farmers. The bureau's annual detailed grasshopper-egg survey is now in progress, and will be completed some time in November. It will then be possible to make a better estimate of damage to be expected next summer.

The one bright spot on the whole depressing grasshopper map, Dr. Larrimer said, is Minnesota. Here an active and informed state government has been cooperating with the farmers and local authorities in an intense eradication campaign for the past two or three seasons, with the result that in Minnesota the grasshopper dam-

age last summer was negligible, while the insect hordes played havoc in states farther west and southwest.

There are four species of grasshopper that figure in the heavy damage, of which the one known as the "lesser migratory grasshopper," offspring of the "Rocky Mountain grasshopper" of pioneer days, has become the worst pest. Its egg-laying habits are such that deep plowing, either in fall or early spring, will reduce its numbers very materially. Farmers in the grasshopper-infested areas are being urged to set their plows for deep furrows this fall, and to use a type of share that turns the top soil completely upside down. If the eggs are buried four inches or more, the young grasshoppers hatch, but are unable to make their way to the surface. Plowing the eggs out upon the surface exposes them to the weather and thus results in partial destruction. However, practical entomologists are agreed that at least part of the eggs survive the winter, and that much more satisfactory results are obtained by plowing them under as deep as possible.

MILK AS A CONSTANT SOURCE OF VITAMINS

MILK, as produced under present market conditions, is a fairly constant source of all the vitamins except the rickets-preventing D and this can be added in a number of ways, Professor H. C. Sherman, of Columbia University, told members of the American Public Health Association recently.

Man has been able to extend his learning period much longer than other animals chiefly because of his use of cow's milk for food, Professor Sherman pointed out. This makes the quality of the milk highly important. The body can not produce vitamins by itself in the way that it can and does produce enzymes and hormones. Either the vitamin or its precursor must be furnished by the food or some other factor of the environment, such as ultra-violet light in the case of vitamin D.

In the case of the cow, the rations which are economically profitable for the dairy farmer to feed are almost always of fairly high vitamin A content, and in addition the cow is able to store a surplus of this vitamin in her body, so that cow's milk is both a highly important and a highly reliable source of vitamin A, Professor Sherman explained.

The rations which are found profitable in modern milk farming are also sufficiently rich in vitamin B to make it fairly certain that the cow's milk will also be a constant and reliable if not outstandingly rich source of this vitamin. This is the more certain because the digestive tract of the cow furnishes a favorable environment for certain vitamin B-producing bacteria, so that the cow may continue to produce milk of normal vitamin B value even when her food lacks this vitamin.

Milk is also a reliable if not rich source of vitamin C. The amount of vitamin D in cow's milk may be increased either by adding vitamin D concentrate to it, by irradiating the milk with ultra-violet light or by feeding yeast or other suitable irradiated material to the cow. Recent work shows that the vitamin D content of the milk may also be increased by exposing the cow to ultra-violet light. There is also considerable evidence that milk as ordinarily produced is a rich and reliable source of vitamin G, important in the prevention of pellagra.

ITEMS

BEFORE trying to give encephalitis or "sleeping sickness" to convicts by the bite of presumably infected mosquitoes, officers of the U. S. Public Health Service have tried the experiment on themselves, as is the custom among medical investigators. Dr. J. P. Leake, in charge of the federal health service's encephalitis investigations at St. Louis, Dr. L. L. Williams, Jr., and Dr. Bruce Mayne, all let mosquitoes feed on patients with the disease and then on themselves. None of them has contracted the disease as a result. This may be because, in the course of their work with the patients, they have already acquired immunity. The next step was to repeat the experiment with ten convicts, volunteers from the Mississippi Penitentiary, who will win their freedom if they survive. It is too early yet to know whether or not they will develop the disease.

A PROPRIETARY medicine now advertised over the radio and apparently new on the market has as its essential drug the dangerous dinitrophenol, the American Medical Association reports. This is the reducing agent which resulted in the death recently of a San Francisco physician who took an overdose in an effort to lose weight. At that time and previously, when the chemical's weight-reducing power was first announced, the American Medical Association warned against the dangers of the drug. Another case of poisoning from it is reported by Drs. Hamilton H. Anderson, Alfred C. Reed and George A. Emerson, of the University of California Medical School, in the current issue of the *Journal* of the American Medical Association. In this case the patient did not die and no overdose was responsible for the poisoning. Instead it appears that this particular patient had a lessened resistance to the drug. She had suffered from arthritis before treatment with dinitrophenol was started.

X-RAYS played upon water or nutrient fluids make them deadly to protozoa presumably by producing very small quantities of hydrogen peroxide. Experiments by which this fact was discovered will be reported in the forthcoming issue of *Physiological Zoology* by Dr. C. V. Taylor, J. O. Thomas and M. G. Brown, of Stanford University. Experimenters first discovered that if they x-rayed a nutrient solution and then put in the species of protozoon they were using, *Colpidium campylum*, the animals died, despite the fact that the deadly rays never touched them. They found the same fate following their protozoa if introduced into x-rayed water. They tested both the culture fluid and the water with titanium chloride, a compound extremely sensitive to the presence of hydrogen peroxide. The test indicated hydrogen peroxide in very small quantities—on the order of one part in a hundred thousand of water. The addition of one part of hydrogen peroxide to 450,000 parts of water rendered it toxic to the protozoa.

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SCIENCE NEWS

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CORONAL LINES IN OPHIUCHI

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DISCOVERY of green and red light spectral lines in the exploding "new star" in Ophiuchi that heretofore have been found only in the sun's corona, invisible except during the rare few minutes of total solar eclipse, promises to solve the most conspicuous riddle in astronomical spectroscopy.

Dr. W. S. Adams, director, and Dr. Alfred H. Joy, astronomer, of Mount Wilson Observatory, California, have announced to the astronomical world, through a telegram to Harvard Observatory, that in a spectrogram of the nova R. S. Ophiuchi taken on October 2 they found the green corona line 5303 strong and the strong red line at 6374 shifted from position of the ionized silicon line previously observed. The present line, they reported, is almost certainly due to corona. These lines have appeared within the past three weeks. The Mount Wilson astronomers find that the structure of the green line is very similar to line 4686 of ionized helium.

"The high significance of this discovery," Dr. Harlow Shapley, director of Harvard Observatory, commented in interpretation, "lies in its direct bearing on the problem of the nature of the sun's corona as well as its relation to the interpretation of novae. These two bright lines have heretofore been found only in spectra of the solar corona, never in stars, and their interpretation has so far baffled astrophysicists.

"The element that gives rise to them is unknown though oxygen has been suspected. Since the unraveling of most of the nebulium mysteries and the identification of the strongest auroral radiations with oxygen, the coronal lines have remained as our most conspicuous riddle in astronomical spectroscopy.

"Finding the lines in recent spectrograms of the exploding atmosphere of the remarkable nova R. S. Ophiuchi may give us important hints as to their source. Their changing behavior as the light of the nova fades compared with the behavior of lines of known origin will help to identify the element and resolve the mystery of the corona."

The so-called "new star" R. S. Ophiuchi was originally discovered as a peculiar variable star identified by Harvard observers. It was later identified through spectral studies as a nova, a star that suddenly increases greatly in brilliance. In August this nova again flared up in typical nova fashion, the first news of this outburst being reported by L. C. Peltier, amateur astronomer of Delphos, Ohio. Immediately astronomers began careful analysis of the nova's fading light and spectrograms taken in green and red light at Mount Wilson Observatory revealed these brightest corona lines. From the Mount Wilson report it is evident that the red line is almost certainly not the well-known line of ionized silicon which is in nearly the same position in stellar spectra.

Since nova spectra change rapidly as the explosion of the star progresses, the Harvard Observatory has notified European and American astronomers telegraphically of the Mount Wilson Observatory observation.

AN UNPREDICTED METEOR SHOWER

A GREAT unpredicted meteor shower, seen from Europe on Monday night (October 9), has been identified with a minor periodic comet that otherwise made no stir in the astronomical world.

In Poland and Belgium astronomers saw the display of "shooting stars" and immediately cabled the news to Harvard Observatory, which is this continent's central station for astronomical telegrams. Dr. Harlow Shapley, director, relayed the news to all observatories and the public, asking cooperation in observing the reported shower.

Dr. W. J. Fisher, Harvard astronomer, checking possible causes of the shower, found that the Giacobini-Zinner comet, a periodic visitor to the sun's neighborhood, was in such a position as to be associated with it. Meteors have been seen but sparsely only a few times in the past in association with this comet. The theory is that the meteors are stray fragments of the comet that plunge into the upper atmosphere of the earth and burn with brilliance that gives the popular name "shooting star." The annual meteor displays of August and November are believed to be due to disintegrated comets, whose fragments travel in the old cometary orbits.

European astronomers who reported the shower were Professor Felix de Roy, of Belgium, and Professor Banachiewicz, of Krakow, Poland. The Poznan Observatory found that the meteors seemed to come from the direction of the constellation of Draco, which is in the northern skies.

The Giacobini-Zinner comet was seen this year in April from Hamburg Observatory on its regular visit to this part of the solar system. It was very faint, within sight of only large telescopes. It was discovered in 1900, rediscovered in 1913 and was observed again in 1926.

A sharp watch will be kept by amateur and professional astronomers all over the world for the next few nights in the hope that the Monday night shower will be repeated.

EFFECTS OF THORIUM DIOXIDE ON THE BODY ORGANS

THORIUM dioxide—a substance injected into the blood to make the spleen and liver radiopaque so that x-ray pictures may be taken of them—produces such definite changes in the liver and bone marrow that its use should be restricted to incurable cases, two University of Wisconsin investigators told members of the American Congress of Radiology. These were Dr. Ernst A. Pohle, professor of radiology, and Dr. Gordon Ritchie, assistant professor of pathology, who based their opinion on the results of two years of research on the effects of the substance on the body organs.

The knowledge of the function of the spleen is not

complete, but it is known that this organ acts as a sort of filter for the blood, taking out foreign substances, and that it has some connection with the formation of the life-giving blood cells of the body.

When the thorium dioxide solution is injected into a vein it mixes with the blood without causing blockage. This substance, however, when once injected does not leave the human system. Instead, it becomes deposited in a special type of cell that is present in the liver, the spleen and the bone marrow, and it remains there. Such injections result in injury to the liver and spleen similar to that sometimes found in acute infections. This damage is followed in both of these organs by moderate scarring, while the bone marrow is stimulated to overactivity and later becomes exhausted.

It is recommended, therefore, "to restrict the intravenous injection of thorium dioxide for diagnostic purposes to incurable cases until evidence to the contrary is presented based on studies in the human that demonstrate without doubt that the changes observed in animals are not significant."

In presenting their conclusions, which are based on the study of results of injections into more than 80 rabbits and the analysis of more than 1,000 x-ray pictures, Drs. Pohle and Ritchie pointed out that they were guided in their work by the assumption that a diagnostic method must not subject the patient to any undue risk or uncontrollable after-effect.

The radiopacity, brought about by the injection of the thorium dioxide, manifests itself from 30 minutes to one hour after the injection, and it lasts in the spleen for as long as 493 days without noticeable reduction in density.

SORTING OF FOODS BY A PHOTOELECTRIC TUBE

SORTING of foods by means of their light reflections will soon be a regular commercial practise, is predicted as the result of the perfection of a device that sorts white pea beans by means of an "electric eye" or photoelectric tube.

Adaptations of the apparatus now in use at a Lowell, Michigan, bean elevator, will make the device applicable to sorting of peanuts, coffee, almonds and other foods in which color is a factor in determining selection. David Clarke Cox, electrical engineer, explained that with a slightly different electrical circuit, it will be possible to sort red kidney beans, green peas and other food crops as easily as white beans are now sorted.

Operating with uncanny precision, a battery of 100 photoelectric cells in the Lowell elevator sorts beans so slightly discolored as to be hardly discernible to the human eye. The machine operates on the assumption that bad beans are discolored. Each bean is brought before a photoelectric cell. If it is spotted or black, an electrical impulse sets into motion a hammer which knocks it away. White beans are passed with approval by the device and no electrical disturbance is set up if the bean is clean.

Hardly larger than a table radio, the individual machine used now consists of a drum with a series of small holes in the rim. As the drum sweeps through a hopper of unculled beans a vacuum from inside the hollow drum sucks a single bean tightly against each hole. The rotating of the drum then presents each bean in review to a photoelectric cell which accurately measures the light reflected. If the bean is discolored, or if a foreign object is presented, a change in the light intensity takes place in the photoelectric tube. This impulse is transmitted to a thyratron tube which permits sufficient current to pass to operate an electromagnet with a trigger-like hammer on one end. Cull beans are dislodged from the vacuum drum by the hammer, while good beans (white) are permitted to pass into a hopper. A dial on the amplifier unit enables a reduction in the sensitivity of the amplifier so that slightly discolored beans may pass undisturbed. This is done at times to serve a certain trade which desires a cheaper product.

The entire operation takes place in a fraction of a second, 13 beans passing the photoelectric tube each second. The machines can do as much work as six girls hand-picking beans and in addition insures uniformity in quality. The machines maintain the same rate of speed whether culls run 2 or 25 per cent.

Possibility that buttons and other colored objects may be sorted by the machine is not far distant, engineers say. The device now in use was among the first combinations of a photoelectric tube and a thyratron tube.

MINING SULFUR UNDER WATER

THE successful mining of sulfur under water has just been reported as one of the outstanding chemical achievements of the year. This comes as welcome news in the face of information that many ideal deposits of sulfur are on the way to exhaustion. Credit for the practical application of the so-called Frasch process, invented a number of years ago, to vast deposits of sulfur under lakes and swamps in Louisiana goes to Lawrence O'Donnell, chemical engineer, and his associates.

Bravely begun during the depression, the project had to overcome economic as well as chemical engineering problems. The yields of sulfur have far exceeded the expectations of the engineers in charge of development and operation. Whereas a plant was built with the expectation of turning out perhaps 300 long tons per day it has reached a production of 1,400 tons and regularly produces 1,200.

The mining is carried out by sinking a shaft 700 feet below the bottom of a lake where a stratum of sulfur 200 feet thick lies. Pipes leading to the plant on the shore are sunk and the sulfur, liquefied by superheated water, is forced out by means of compressed air. To date 200,000 tons of sulfur of 99.92 per cent. purity have been taken from the wells.

Lake Peigneur, where the mining is being carried out, contains half a dozen small islands formed by the pressure of plugs of salt originating five miles down in the earth. The great pressure there causes the salt to become plastic and it forces its way through faults and fissures to a point below where the sulfur is found. Hence salt is likewise very profitably mined in this locality. In fact it is these "salt domes" that force the

sulfur nearer the surface of the earth. Oil is also found in the capping rock and on the sides of the domes. The Gulf States are of course noted for their oil deposits.

ANIMAL LIFE IN THE NATIONAL PARKS

As the tourist season ends in the national parks of the West, a general check-up shows that the wild animals given protection therein generally are facing the winter in good condition, after a favorable summer. One or two situations, however, are causing concern.

The superintendent of Yellowstone National Park has informed the national parks office that the forage available for the northern herd of Yellowstone elk is not adequate and that a serious situation may arise should the coming winter be a severe one. Contributing causes are a series of dry years that have resulted in a poor forage crop, and over-grazing caused by heavy concentration of elk just inside the northern park line at Gardiner, Montana, and in the Lamar River district of the park at the junction of the Lamar and Yellowstone Rivers. As a matter of fact, both the northern and southern elk herds have increased to the point where there is a serious problem of furnishing sufficient winter feed.

Commenting on this situation, Dr. Harold C. Bryant, whose supervision of research and educational activities in the national parks includes wild-life problems, states that national park authorities are determined upon a policy of reducing the amount of artificial feeding, with particular reference to cottonseed cake. It is their purpose to get the elk, particularly the northern herd, back on a self-reliant basis so as to present typical wild elk herds to visitors and not animals semi-domesticated through feeding. This they hope to achieve through the acquisition of additional natural feeding grounds and the control in numbers that will result from normal winter kills when artificial feeding is stopped.

An interesting observation from Mount McKinley National Park, Alaska, where an increase this year of all park animals was reported, is that the caribou, mountain sheep and moose fare better in extremely cold weather with a light snowfall than in moderate winters with heavy snows. Last winter the caribou remained in the park for the first time in many seasons.

Animal life in Glacier National Park did well on the whole during the past season. Nevertheless on the east side a problem faces park authorities to determine the cause of the scarcity of wild life in that section.

Moose are greatly on the increase in Yellowstone, Glacier and Grand Teton National Parks and are seen more and more by visitors. Mountain sheep and mountain goats in the parks, while they show no great increase, seem to be in excellent condition.

The special protection given trumpeter swans in Yellowstone National Park for the past several seasons resulted last summer in the return of these great birds to Swan Lake, a body of water that they have neglected for many years. Since the lake has little cover for birds, their use of it indicates an increase in number and a resultant spreading to less desirable locations.

ITEMS

UNUSUAL precautions are being taken by Lieutenant-Commander T. G. W. Settle in preparations for his second attempt to reach the stratosphere from Chicago. He is expected to make another ascension in a few days, using the balloon and gondola that were forced to earth by a leaking valve at the time of the first take-off. Although the preparations are largely secret, it is known that the "Century of Progress" gondola, punctured and dented by the forced landing in a railroad yard, has a complete new bottom, and has been tested with air pressures up to forty-five pounds per square inch, three times the pressure it will have to withstand in the stratosphere flight.

THE Federal Emergency Administration of Public Works is laying special emphasis on getting men and jobs together in the North, where a lockout of most forms of outdoor labor is enforced by the weather. Secretary Harold L. Ickes, in his capacity as Federal Public Works Administrator, has had a special work-weather map compiled for the guidance of federal officials and members of the various State Advisory Boards. The weather embargo on out-of-door work begins as early as November 1 in northern Minnesota and North Dakota, the map indicates. By December 1 the no-work line has moved down until it crosses central Nebraska and Iowa, southern Wisconsin and central Michigan, and northern New York and New England. By the end of the year the freeze-out is complete above central Kansas and Missouri and the southern ends of the Ohio Valley states. All-winter work is possible in Dixie, the Philadelphia area and most of New Jersey. In the West, Arizona, California and the coast and valley areas of Washington and Oregon are similarly favored.

A SERIES of experiments which throw further light on the cause and cure of pernicious anemia and confirm some of the latest results of American research workers, has been made by Drs. John F. Wilkinson and Louis Klein, of the Department of Clinical Investigations and Research of the Royal Infirmary, Manchester. They have found that the blood-producing factor in hog's stomach, which is now used as an alternative for liver in checking the disease, will yield a substance resembling the blood-producing factor in liver if it is incubated with beef muscle in the laboratory. Because of the chemical differences between the blood-producing substances in liver and in stomach their similar curative actions in anemia have previously puzzled scientists.

MANKIND is by no means alone in being subject to the affliction of tumors and other cancerous growths. A study of tumors occurring in animals of the Philadelphia Zoological Gardens has been reported to the *American Journal of Cancer* by Dr. Herbert L. Ratcliffe, of the University of Pennsylvania. A review of more than 5,000 animal autopsy records shows the occurrence of these afflictions in about two per cent. of all the animals dying in the gardens. Mammals were much more frequently affected with tumorous growths than were birds, although there were more birds than mammals on record in the series of autopsies. Malignant growths were found among the lowly opossums and other marsupials as well as among the dominating carnivores and the primates. Dr. Ratcliffe notes, however, that among all the orders of mammalia, the primates showed the lowest incidence of tumors.

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SCIENCE NEWS

Science Service, Washington, D. C.

A NEW CYCLE OF SUNSPOTS

THE spottedness of the sun is at a low ebb. The old cycle of sunspots has nearly run its course. Any day now Mount Wilson Observatory astronomers would not be greatly surprised to see on the sun's face the first of a new family of spots, the leader in a new cycle of spots that will last nearly eleven years.

The sun continued to be nearly inactive in July and August, with only five spots, all belonging to the waning cycle. In August the number of groups was lowest since 1923 when the last minimum in sunspots occurred. In September there was a slight increase in the number of spots, but this was due, Dr. Seth B. Nicholson, Mount Wilson astronomer, suggests, to a secondary and short-period fluctuation in the sun's spottedness, not to the beginning of another of the long cycles such as have been traced for centuries past in astronomical records and in natural phenomena such as tree rings.

Dr. Nicholson explained that the low level of solar activity may continue for several months and may even extend into 1934. The time between sunspot minima has been about 10¼ years and if the waning cycle is of that length, the exact time of minimum should be this month or next. The astronomers can not generally tell just when is the real turning point until some months after it occurs.

Sunspots are gigantic disturbances in the luminous layer or photosphere of the sun. The dark central part or umbra of spots varies in diameter from 500 miles to some 50,000 miles. The earth could be lost in the swirl of the larger spots. Sometimes the large sunspots can be seen with the unaided eyes when the sun is dimmed in setting or when a shade glass is used in viewing it.

The German astronomer, Schwabe, in 1843, first discovered that the number of spots varies greatly in different years and shows an approximately regular periodicity of about eleven years.

Dr. George E. Hale, now director emeritus of Mount Wilson Observatory, discovered that when the sunspots appear in pairs the leading spot is opposite in magnetic polarity from the following spot. The spots in the northern hemisphere of the sun are also opposite in sign from the analogous spots in the southern hemisphere. He also found that the sun is a giant magnet much like the earth in this respect.

At the beginning of a new sunspot cycle, the spots appear in high latitudes and the magnetic polarity characteristic of each hemisphere is reversed, and in this way astronomers now know that a new cycle is about to begin. Dr. Nicholson explains that the appearance of a new cycle spot will not mean that the exact time of sunspot minimum has arrived as the first spots of a new cycle often appear a month or two before the minimum.

Nearly every sort of earthly phenomena from war, birth rates and crop failures, to magnetic storms and auroras, have been linked to sunspots by scientific enthusiasts. There is good observational evidence that sunspots and changes in the magnetism of the earth are related. Astronomers report that the sunspot minimum now about due will have no real major effect on earthly conditions.

YELLOW SODIUM VAPOR LIGHT

FOR revealing the detail of small colorless objects, the yellow single-color light from sodium vapor is definitely and significantly superior to the ordinary light from incandescent tungsten filament lamps such as are used in every-day lighting.

At the recent meeting of the Optical Society of America, Drs. M. Luckiesh and Frank K. Moss, of the General Electric Company Lighting Research Laboratory at Cleveland, reported an appraisal of the visual effectiveness of the new sodium vapor light, about to come into specialized commercial use, as compared with the familiar tungsten filament light.

The advantage of one illuminant over the other depends upon the purpose for which the light is used, the investigators concluded. In addition to revealing details better, the speed of retinal impression is also higher under sodium light for objects that occupy only a very small part of the field of vision.

On the average the proportion of light reflected by a large variety of colored specimens is practically the same for both illuminants, although there is wide variation in individual colors. Sodium light enhances brightness-contrast between various pairs of colors in more cases than tungsten light does, but there are many exceptions.

The yellow sodium light often plays strange tricks upon eyes that are accustomed to white light, but measurements of nervous muscular tension as a result of reading gave in the reported experiments no indication of a difference in the behavior of the human seeing-machine under the two illuminants.

A NEW PRINCIPLE IN TELEVISION

THE iconoscope, newest advance in television, was described by its inventor, Dr. V. K. Zworykin, of the R.C.A.-Victor Company, before a recent meeting of the Franklin Institute. The device, which is the closest artificial simulation of the human eye yet devised for use in television, has no scanning disk or other moving parts. The only thing about it that moves is a thin stream of electrons, which are played back and forth across a sensitive artificial "retina" by changes in a magnetic field.

The receiving or "seeing" end of the instrument consists of a flat plate, representing the retina or sensitive inner surface of the eye. On this, as on a photographic plate, the scene to be "televised" is focused. This retinal plate contains many thousands of tiny silver globules, each made sensitive to light by chemical treatment with the element caesium. The degree to which these minute photocells will transmit an electric current is changed according to the brightness of the light or the darkness of the shadow that falls upon them.

The electric current is carried to this plate by the

stream of electrons, which has a constant electrical potential. The stream is pulled rapidly back and forth across the plate by means of a set of electro-magnets. If it falls upon a bright spot, it receives a boost; if on a dark one, it is cut down a little. Thus the electric current that leaves the retinal plate fluctuates up and down. This fluctuating current is sent, *via* wire or radio waves, to the distant reproducing station.

At the reproducing end, the transmitting current is used to shoot out another stream of electrons, which varies in strength with the fluctuations in the current. Pulled by another set of electro-magnets, it plays rapidly back and forth across another screen, which shines when the electrons bombard it strongly, is dark when they do not. Thus the original scene is reconstructed.

BALL LIGHTNING PHENOMENA

BALL lightning, one of the least understood of the electrical phenomena of the air, seems to be connected with the clouds of dust blown before a "line squall" wind or a tornado. Such at least has been the observation of Professor J. C. Jensen, of the department of physics at Nebraska Wesleyan University, who reports in the October issue of *Physics*. One ball lightning display took place during an August thunderstorm while he was getting photographs and scientific records of ordinary lightning and the other phenomena accompanying it.

The cold air rushing ahead of the storm cloud was filled with a swirling mass of dust, he says. Brilliant lightning flashes were seen descending in rapid succession from the cloud to the earth. In the wake of one of these flashes there appeared a shapeless mass of lavender color which seemed to float slowly downwards. The mass seemed most brilliant near the ground, and gave the impression of a gigantic pyrotechnic display. Two or three glowing globular structures seemed to roll along a pair of high-voltage power lines for a hundred feet or more, then bounced down on the ground and disappeared with a loud report.

Professor Jensen's photographs showed these strange and weirdly beautiful objects plainly. Knowing the lens-angles of his cameras and the distance to the power line, he was able to calculate their size. One of them had a diameter of about 28 feet, and the other was some 42 feet across. These figures are much larger than those usually given for ball lightning.

A second ball-lightning display reported by Professor Jensen was seen during a tornado in Iowa by George Raveling, a U. S. Weather Bureau observer. As he described it: "From the sides of the boiling, dust-laden cloud a fiery stream poured out like water through a sieve, breaking into spheres of irregular shape as they descended. No streak lightning of the usual type was observed and no noise attended the fire-balls other than the usual roar of the storm."

AUTOMATIC TRAP FOR WEEVIL LARVAE

EXPLOITING an insect pest's strange taste in egg-laying places to her own undoing is the newest bit of strategy in the unending war between man and his six-legged enemies, turned to account by Dr. George N. Wolcott, of the Puerto Rico Insular Experiment Station.

One of the most numerous and troublesome of all West Indian insect pests, Dr. Wolcott says, is a large leaf-eating weevil known locally as "vaquita"—literally translated, a little cow. So common and so unpopular is the insect that Puerto Rican students have transferred the name to a much-disliked island politician.

This weevil normally lays its eggs between two leaves, or within the cleft of a split cane leaf. But entomologists who have reared "vaquita" in captivity for research purposes found that it preferred laying its eggs between two sheets of paper. Now Dr. Wolcott has made a test under field conditions, and finds that outdoors as well as in breeding cages, the beetle still prefers paper as an egg-laying place. He set up stakes bearing paired strips of paper alongside of a number of citrus seedlings, and found that the insects laid their eggs between the loose ends of these "paper flags."

The economic application of this insect's strange preference depends on the glue-like substance in which the eggs are imbedded when they are laid, which normally sticks the two sheltering leaves together.

"An exceptionally effective adhesive is required to stick together two shiny citrus leaves so that they will remain in close adherence until after the hatching of the enclosed eggs," according to Dr. Wolcott. "Such the beetles possess. It is so effective indeed that the emergence of the young grubs from hatching egg-masses is often delayed for several hours or days until a thin place in the ring of it laid around the egg-mass by the female can be found.

"When used for ovipositing between two sheets of paper, it is so much more effective than is necessary that the just-hatched grubs can not emerge, but, imprisoned within its cellophane-like ring, dry up and die. In nature, they never attempt to burrow through the leaf to escape from the egg-clusters, and under the artificial conditions of egg-clusters between paper, they do not attempt to burrow through the paper.

"Thus, once the paper flags are in place, they form an automatic trap for the eggs of the beetles, not needing to be renewed until the paper itself becomes soft and weathered. In the tropics, the traps remain effective for at least three months, using thin, tough wrapping paper."

Dr. Wolcott's studies have been reported to *The Journal of Economic Entomology*.

THE CONTROL OF WHITE PINE BLISTER RUST

PROTECTION of thousands of acres of white pine from the ravages of blister rust is one of the accomplishments of the Civilian Conservation Corps in the past few months, according to a report of the U. S. Forest Service.

With the falling of the leaves, the work for the current season is now practically ended, after extensive operations in the major white pine areas of the country.

Blister rust control was the major job of thirty-five conservation camps in northern Idaho, where vast acreages of western white pine are threatened. Seven thousand young Conservation Corps workers were dis-

tributed through the heart of the best white pine country in and adjoining the Coeur d'Alene, St. Joe and Clearwater National Forests, working on government, state and private lands.

Control work was also done in the Lake States and in the Northeast, on national, state and private forest lands, and to some extent in portions of the national forests in Pennsylvania, Virginia, West Virginia and eastern Tennessee. The work on the national forests was directed jointly by the U. S. Forest Service and the blister rust control division of the Bureau of Plant Industry.

The disease is controlled by the eradication of currant and gooseberry bushes of the genus Ribes, which form the alternate hosts for the blister rust fungus, and spread the disease to the pines. Control work was done both by hand pulling and by the use of chemicals. It was necessary to cover every foot of ground to find all the wild currant bushes.

In the northern Idaho operations each strip covered was marked by a string line and the crews working in that section this season used 40 tons of cotton twine, laying out some 56,000 miles of line. The chemical crews worked the concentrations of wild black currant in the damp stream bottoms, spraying the plants with a commercial weed killer. About 225 tons of chemical were required for the Civilian Conservation Corps forces in the northern Idaho region.

Blister rust control is hard and monotonous work. It involves constant struggling through thick brush and down timber on steep slopes in the hot sun, but, according to Forest Service officials, the crews rapidly became seasoned to the job and turned out some excellent work.

With the closing of the blister rust control work season, now that the frost will be knocking the leaves from the Ribes plants, the workers on this project are turning to tree planting, truck trail construction and other jobs on the forestry work program.

ITEMS

A NEW comet was discovered by Dr. Fred L. Whipple, of the Harvard College Observatory, shortly after midnight on Saturday, October 21. It is at present in the constellation Taurus, the Bull, a little south of the familiar compact group of stars, the Pleiades. These two constellations may be seen low in the east at about nine o'clock in the evening. The new comet is moving slowly in a southwesterly direction. Its position, in the astronomical equivalents of latitude and longitude, was right ascension three hours twenty-three minutes, declination plus nine degrees twenty-two seconds, when discovered. The new visitor to our part of the solar system is not yet visible to the naked eye.

SOUND travels fast through solid rock. How fast, Dr. L. Don Leet, of the Harvard seismograph station, has been finding out by exploding dynamite and getting the travel records on earthquake-detecting instruments at a distance. These data are of value in calculating the elasticity and compressibility of the rocks, which in turn help to make earthquake records more accurate and intelligible. Dr. Leet made his set-ups in two places, one on granite at Rockport, Massachusetts, and the other on norite, an ancient igneous rock, at Sudbury, Ontario. He found that his dynamite-engendered longitudinal earthquake waves traveled through the granite at nearly 17,000 feet a second, and through the norite at over 20,000 feet a second. This is high speed compared with approximately 1,100 feet a second, which is the velocity of sound in still air. Dr. Leet's studies are reported in the October issue of *Physics*.

THE oft-repeated and widely believed declaration that the Baltic Sea is slowly becoming a fresh-water lake is not true, Professor V. Berg, well-known oceanographer, told the Fourth Hydrological Conference of the Baltic Countries at its meeting in Leningrad. So much fresh water flows into the Baltic that if no new salt water were added, the sea would contain nothing but fresh water after 187 years, mathematical calculations have indicated. But new salt water is constantly being carried into the Baltic by the currents that sweep through its narrow entrance. The amount of salt added depends on the salinity of the North Sea, and this varies from year to year. However, even as it is, Baltic water is much less salty than the water of most large arms of the ocean. North Sea water is usually from one and one half to two times as salty as that of the Baltic. And its northern arm, the Gulf of Bothnia, lying between Sweden and Finland, with its entrance partly blocked by submarine ridges, has water even less salty than that of the Baltic.

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SCIENCE NEWS

Science Service, Washington, D. C.

CORONAL LINES CAUSED BY OXYGEN

THE mysterious and hypothetical element coronium, to which for years the major part of the radiation from the sun's halo or corona has been attributed, turns out to be the common element oxygen.

In 1869, when a solar eclipse path crossed the United States, green lines in the spectrum of the sun's outer envelope caused astronomers to assume an unknown element and name it after the sun's corona. The corona is visible only during the few minutes of total solar eclipse.

Now Dr. D. H. Menzel, of Harvard Observatory, and Dr. J. C. Boyce, of the Massachusetts Institute of Technology, have made the first important step in unraveling this astronomical mystery that has existed since the first observations of the coronal spectrum more than sixty years ago. Their analysis identifies three of the five strongest coronal lines with neutral oxygen atoms in the high solar atmosphere. These atoms are in very peculiar states of excitation. Thus the life-supporting gas in the earth's atmosphere promises to explain another of the mysteries of the heavens. For oxygen has heretofore been shown to be the cause of light from far-off nebulae and from the aurora or northern lights of the earth's atmosphere.

"The light of the gaseous nebulae was long attributed to the hypothetical element nebulium," Dr. Harlow Shapley, director of the Harvard Observatory, explained in commenting on the coronium-oxygen identification. "A few years ago the nebulium mystery was solved by finding that highly ionized oxygen and nitrogen were largely responsible for the radiation. Also in recent years the mysterious light of the aurora has been assigned to oxygen."

Careful checking of the "flags" that are flown by the elements in spectrum photographs made possible this latest discovery. These "flags" are lines that appear when light is dispersed by a prism. Bright lines or bands of light, beautifully colored, are caused by the radiation given off by various chemical elements heated to incandescence. Sunlight, which forms the rainbow of a showery day or the rainbow of the physicist's spectroscope, contains a wide array of light from numerous elements. By matching the spectral lines of light from the sun, stars and other otherwise inaccessible sources with those from known elements, scientists have been able to prove the existence of various earthly substances in other parts of the universe. Helium, which is now rated as a useful and fairly available elemental gas, was discovered in the sun's chromosphere during the eclipse of 1868 as a bright yellow line. Not until 1895 was it discovered here on earth chemically.

In a similar way the hypothetical element coronium came into existence because coronal spectral lines were found that could not be linked to any known element. As more and more of the ninety-odd chemical elements were discovered and studied without being proved to be coronium, scientists began to feel confident that coronium was a common element in masquerade. Drs. Menzel and Boyce have now produced the first definite evidence. The solution of the mystery of coronal radiation was assisted greatly by the recent discovery at Mount Wilson Observatory that the new star Nova Ophiuchi also shows coronal lines at one stage of its explosive outburst. The investigators used corona spectrum photographs obtained at the 1932 eclipse, which was successfully observed by the Harvard Observatory party. It is probable that after this important start made by Drs. Menzel and Boyce the other coronal lines will soon be interpreted.

The Harvard Observatory announcement states that Drs. Menzel and Boyce find that the frequency difference between two coronal lines (wave-length 6374 and wave-length 3454) agrees with the difference between two known high energy states of the neutral oxygen atom. This suggests that the lines are produced by combinations with a higher energy state. Calculation shows, the announcement states, that the oxygen atom should possess energy states of about this value. A theoretical extension of the data predicts that a line should be found at approximately the wave-length of a third prominent coronal line (wave-length 3987).

ATOM DISINTEGRATION BY HIGH-SPEED DEUTONS

ATOM smashing has revealed new secrets about the hidden energy of the building blocks of matter that may some day serve as power in a super-machine age civilization.

These new advances were reported on by Dr. Ernest O. Lawrence, professor of physics at the University of California, at the meetings of the Solvay International Institute of Physics held in Brussels. Dr. Lawrence, with his colleagues Drs. M. Stanley Livingston and Malcolm C. Henderson, has also communicated his research results to *The Physical Review*.

The whirligig atom-gun invented by these modern alchemists has fired the most energetic atomic projectiles ever produced by artificial means. Dr. Lawrence and his collaborators forced the hearts or nuclei of heavy or double weight hydrogen, called deutons, to whirl about in a vacuum. Twice during each circular trip these deutons are fed more electrical energy. Finally they are stepped up to the almost unbelievable speed of 3,000,000 volts, the most energetic particles ever controlled by man.

Then these atomic bullets bombard targets of platinum, brass, wax and many other chemicals. Atomic disaster is the result of these collisions between the deuton bullets and the target atom hearts. The fragments of these atomic explosions flying out are caught and measured. These measurements tell the physicists the story of the atomic disaster.

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companion fragment to the proton is called the neutron and has the same weight but no electrical charge. This particle also flies out with an energy of 2,400,000 volts.

The results of the collisions are interpreted from the disintegration fragments. It is concluded that the deuton bullet itself has been broken up and 4,800,000 volts of energy have been released as a result of this disaster. The deuton has to be very close to the target atom's heart before this disintegration will occur.

Very seldom do the right conditions exist for the release of this enormous amount of energy. So seldom, in fact, that Dr. Lawrence states that the best targets gave only two disintegration protons for every 10,000,000 deuton bullets bombarding the target. The process is so inefficient that it is only detected by very delicate scientific instruments and as yet can not be thought of as a commercial source of powerful energy.

STREAMLINED AUTOMOBILES AND POWER CONSUMPTION

THE automobile of 1933 consumes 30 per cent. less power in overcoming air resistance than its predecessor of 1928, wind-tunnel measurements on models by R. H. Heald, of the U. S. Bureau of Standards, show. This improved performance comes as a result of the modern trend toward streamline form. The tests showed, however, that the air resistance of the 1933 car is more than twice that of a completely streamlined car of the same frontal area.

The aerodynamic characteristics of six small-scale replicas, ranging from one quarter to one fifteenth natural size, were studied in the wind-tunnel at air speeds from thirteen to seventy miles per hour. These six models were a 1922 sedan, a 1922 touring car, a light sedan of 1928 and of 1933, and two models of the autos of tomorrow. The 1933 model was a composite model and not an exact duplicate of any actual make. It was equipped with disk wheels, exposed bumpers, fenders, headlights and spare tire. One model of the auto of the future differed from it in having the windshield inclined at a 45 degree angle, the top rounded front and rear, and a general smoothing of lines. The other model of the future presents a radical departure in design; the whole upper is rounded, blunt in front and tapered to the rear so that it resembles a section from a thick airplane wing. The wheels of this car are enclosed in the body.

Mr. Heald measured the resistance offered by these models to air currents of known velocity and from these data he obtains the so-called drag coefficients which express the aerodynamic efficiency of the model. These coefficients ranged from 0.0017 for the 1922 sedan, 0.0018 for the 1928 sedan, 0.0014 for the 1933 sedan to 0.0005 for the ultramodern car of the future.

The significance of these figures can be more readily appreciated when these drag coefficients are converted into horse-power consumption for an actual automobile. At a speed of 60 miles per hour air resistance uses 27 horse-power for the 1922 sedan, 33 horse-power for the touring car of the same period, 26 horse-power for the 1928 sedan, 18 horse-power for the 1933 sedan and 8 and 6 horse-power for the two streamlined models. The slight improvement of the 1928 model over those for 1922 is due, not to any improvement in aerodynamic design, but to a reduction in frontal area, and to a lesser extent this is true also of the 1933 car as compared to the 1928 model. At 48 miles per hour the power consumption due to air resistance is only one half of that at 60 miles per hour, while at 76 miles per hour it is doubled.

A striking feature of Mr. Heald's results is the prediction that the 1933 automobile, shorn of its projecting bumpers, headlights and spare tire, fitted with a sloping windshield and a rounded top, would consume 10 horse-power less at 60 miles per hour, and about 20 horse-power less at 70 miles per hour. This would effect a considerable saving in gasoline.

The completely streamlined, aerofoil type, as represented in the most advanced of Mr. Heald's models, offers a further slight improvement in performance, but this would only be of practical significance at considerably higher speeds. However, Mr. Heald points out that an automobile body of this shape would act like an airplane wing and at high speeds would produce a lifting force. The effect of this lifting force on performance has not yet been investigated.

A REPORTED ANCESTOR OF THE HUMAN SPECIES

DISCOVERY of a jaw belonging to an ancestor of the present-day human species was reported at a session of the Anthropological Institute, London, by Dr. L. S. B. Leakey.

The discovery, if accepted according to Dr. Leakey's interpretation, would mean that human history and evolution are pushed back into a much more distant past than anthropologists have assigned to man.

Dr. Leakey, whose excavations in East Africa have been a subject of much scientific discussion, announced that the new-found jaw represents a new species, which he called *Homo kanamensis,* in honor of Kanam in East Africa where the jaw was unearthed. The evidence of a new species is based on radiological examination of the jaw. This x-ray test, it was said, showed distinguishing features in the roots of the teeth, marking an evolutionary trend towards *Homo sapiens,* the species to which all modern races of men belong.

It was stated that the man represented by these skeletal remains lived in the Lower Pleistocene age, which would give this early species an antiquity of about half a million years. He would thus be a contemporary of *Pithecanthropus erectus.* Pithecanthropus, so-called ape-man of Java, is a far more primitive type, and has long been rated as the most venerable proto-man ever found on earth. The new discovery would imply that a much higher type of man, and a direct ancestor of the species of man that survived into modern times, lived on earth at an ancient date. The jaw found at Kanam shows a development of chin and arrangement of teeth that are similar to *Homo sapiens.*

Another skull from East Africa, the Kanjera skull, was stated by Dr. Leakey to be Middle Pleistocene in antiquity and to represent a generalized primitive type of

Homo sapiens. The shape of the femur or thigh bone shows that this man walked erect. Development of a culture using hand axes of stone can be traced in East Africa.

ENCEPHALITIS AND MOSQUITOES

TEN Mississippi convicts who risked their lives to aid science left the state prison at Parchman on November 1.

Their liberty is being restored as a reward for their heroic service to the society against which they committed their crimes. They furnished proof that encephalitis, sometimes called sleeping sickness, is not carried by mosquitoes.

This enables investigators, seeking to protect society from the disease, to narrow the range of investigation and to come closer to knowledge of how the disease is transmitted.

Another group of convicts, volunteers from the Virginia state prison, are giving further proof that mosquitoes do not spread the disease. These men served as subjects later than the Mississippi group. The remainder of their sentence, which runs to the middle of November, will be cheered by the knowledge that their release from danger of illness and from imprisonment is now almost certain.

One month ago the Mississippi convicts volunteered to act as subjects in the experiments that Dr. J. P. Leake and his associates of the U. S. Public Health Service were conducting during the epidemic of encephalitis that struck St. Louis early this fall. The epidemic ran out its course by the middle of October, but the experiments were continued in the hope of finding means of preventing another such outbreak.

Mosquitoes were suspected of spreading the disease in St. Louis. So that the experiment was made of trying to transmit the disease to healthy men by the bite of mosquitoes that had previously fed on encephalitis patients. The investigators first tried the experiments on themselves. But since they had been in the thick of the fight all along, visiting patients and handling their infected blood, they might have developed resistance to the disease which would protect them against even the bite of an infected mosquito. The convicts had not been so exposed. However, mosquitoes also failed to infect them, although more than twice the usual time necessary for the disease to develop after infection has elapsed.

ITEMS

THE Whipple comet has been found on a photograph taken with the 16-inch Metcalf telescope at the Oak Ridge, Massachusetts, station of the Harvard Observatory on October 15 and also on several plates taken on October 20. Professor George Van Biesbroeck, of the Yerkes Observatory, has confirmed the discovery of the comet by Dr. Fred L. Whipple, of Harvard, by reporting a position determined on Sunday. Dr. Whipple's finding of the comet was bulletined to astronomers throughout the world last Saturday. It is of 13 or 14 magnitude and therefore visible only in larger telescopes.

A SURVEY of recent weather conditions by the U. S. Weather Bureau shows that the continuation of last summer's long drought in the southwestern winter wheat areas is hampering the fall planting program in parts of Oklahoma and Kansas. The lack of rain is also felt in the Great Plains region from Nebraska on northwards. Farther east, conditions are more favorable, and fall-planted grains are already pretty well in. Autumn rains, regionally at least, have caused some interference with harvesting, as in the eastern Iowa corn area and in the northwestern part of the Cotton Belt.

SHARP earthquake disturbance in the interior of Bolivia was indicated by a study of data collected telegraphically by Science Service and interpreted by seismologists of the U. S. Coast and Geodetic Survey. The quake began at 6:28 P. M., eastern standard time, on Wednesday, October 26. Its epicenter was in approximately 22 degrees south latitude, 67 degrees west longitude. This point lies in the Bolivian state of Potosi, about 350 miles northeast of Antofagasta, Chile. It is an interior mountain region, without good communications to the outside, so that if property damage or loss of life have resulted there may be a lapse of several days before a direct report reaches the world. The present report is based on instrumental data alone.

IF you were to travel over all the shoreline of the United States and its possessions, you would cover a distance greater than four times the circumference of the earth at the equator. The task of mapping all the territory, more than 103,000 miles in length, is one performed by the U. S. Coast and Geodetic Survey. Captain R. S. Patton, director of the survey, reports that 21 new charts and 152 new revisions of existing charts were issued by this bureau during the past fiscal year. The total number of nautical charts now issued by the survey is 752, and these are supplemented by 5,515 coast and intracoastal pilots, 31,609 tide and current tables, and 958 tidal current charts.

NOT only the height of a building or of a tree, but also the nature of the ground on which it rests, is of prime importance in determining whether it will be struck by lightning. That lightning chooses the path of least electrical resistance is the contention of L. N. Bogoiavlensky, of Soviet Russia, in a letter to *Nature*. The resistance of the air, he explains, is influenced by the radioactivity of the rocks below it, since radioactive materials constantly give off radiation which increases the ionization and the electrical conductivity of the air. From the frequency with which the supports of an electrical power line have been damaged by thunderstorms, Dr. Bogoiavlensky shows the parallelism between the number of lightning flashes that strike the ground, the electrical conductivity of the air and the distribution of radioactive rocks below the surface of the ground. These rocks lie sometimes at considerable depths, more than one hundred feet, but their radiation seems to be effective. The measurements which led to these findings, used in choosing the location of power lines, radio transmitting stations, etc., were carried out in the outskirts of Leningrad, Moscow and Cheljabinsk in the Ural, by the Radiological Department of the Central Chamber of Weights and Measures, Leningrad.

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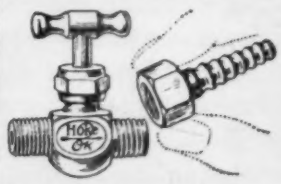

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SCIENCE NEWS

Science Service, Washington, D. C.

COLORS AND THE HUMAN EYE

IF the sky is viewed through a narrow, blackened tube its usual "blue" appears white, clouds are seen to be yellow, purple turns to pink, and a beautiful sunset becomes a mixture of tawdry colors. This fact was mentioned by Professor J. B. S. Haldane, the physiologist, chemist and philosopher, as an illustration of his theory of vision. He explained the theory in delivering the inaugural address to the 197th annual session of the Edinburgh Royal Medical Society.

The apparent hues of a glorious sunset are not "really there." They are an illusion created by the human eye in an attempt to make the sunset conform to the "normal" color-balance in the field of vision. The familiar blue of a clear sky is in part imposed by the eye to balance the brilliant yellow rays of the sun. What we see depends, Professor Haldane believes, as much on the peculiar reactions of the eye to external stimuli as on the stimuli themselves.

Professor Haldane formulated his theory as follows: 1. In the perception of either color or brightness our vision as a whole is always active; there is no merely objective cause of color or brightness. 2. In this active perception we can distinguish the coordinated maintenance of color and complementary color, as well as brightness and darkness, in the field of vision.

If his theory be true, the assumption on which Galileo and Newton founded physics, that "our sense-organs are simply receptive of various kinds of impressions from a surrounding physical world," does not cover the facts. Newton, in his "Opticks," had assumed that the color of any light depended solely on its refrangibility, or wave-length. Professor Haldane showed with experiments that he could make light which, by the laws of physics, ought to be yellow, turn blue, white, green or any other color, merely by changing the whole of its background.

A small area of a white screen lit by a daylight lamp appeared blue when viewed through a hole in another screen lit by a yellow lamp, and green when the front screen was lit by a red lamp. After a few moments the front screen appeared to be white, although actually it was still lit up by the red lamp. It is necessary for an object to be given the eye's whole attention if its "true" color is to be determined.

COSMIC RAYS

WHEN high-speed cosmic rays from outer space hit atoms or other material particles on arrival in the earth's atmosphere and thus start a shower of slower, secondary rays, the energy put in by the primary rays appears to be equalled by the energy in the resulting secondaries. Thus the physical rule known as the law of the conservation of energy would seem to hold good in this new border zone of the realm of physics.

Evidence suggesting that this is the case has been found by a 23-year-old student at the famous Cavendish Laboratory at Cambridge University, C. W. Gilbert. This evidence is the result of experiments seeking the thickness of lead armor that would produce the best results when used over batteries of instruments that register the arrival of showers of electrically charged particles started by cosmic rays. At sea-level the best thickness of this lead armor was found to be 16 millimeters (approximately five eighths of an inch), which indicates an average energy of 70,000,000 electron volts in the arriving shower particles. On the heights of the Jungfrau in Switzerland, 11,500 feet above sea-level, the maximum thickness was found to be 22 millimeters (approximately seven eighths of an inch), corresponding to an average of 95,000,000 electron volts. This Mr. Gilbert interprets as indicating that the law of the conservation of energy is followed in the generation of secondary cosmic rays.

Mr. Gilbert's data and interpretations have not yet received technical publication. Early next year he will present a paper on them before the Royal Society. Mr. Gilbert is a former pupil of Professor P. M. S. Blackett, co-discoverer of the electron.

THE WEIGHT OF A NEUTRON

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AMERICAN ultra-modern alchemists working at the destruction and creation of new atoms from old have found that one of science's newly discovered building blocks of matter called the neutron is much lighter than English physicists have measured.

Dr. Ernest O. Lawrence, addressing the meetings at the Solvay International Institute at Brussels, told how he and his colleagues, Drs. M. Stanley Livingston and Malcolm C. Henderson, of the University of California, have again used their whirligig atom-smashing machine to pry into the hearts of atoms. Accelerating the hearts of heavy hydrogen atoms, which are called deutons, up to the enormous energy of 3,000,000 volts, they have bombarded the rare light metal beryllium.

These are the most energetic atomic particles ever produced by man and the most efficient atom-destroying bullets ever devised. From the results of the bombardment it is concluded that the beryllium disintegrates. Among the fragments flying out as a result of the explosion are neutrons. These neutrons are electrically uncharged particles similar to the hearts of ordinary hydrogen atoms called protons.

The California investigators say that the neutron weighs 1.0006 mass units. Professor J. Chadwick, of Cambridge University, England, last year said that the neutron weighs 1.0067 mass units. This little difference in mass means an enormous difference in energy for it is from the transformation of mass into energy that modern alchemists hope to realize the Utopia of the future where all the energy necessary to run the world will come from the actual transformation of weight into driving power.

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ordinary beryllium of isotope number 9 results in a transmutation of elements. Beryllium is changed into boron of isotope number 10 and a neutron. Assuming this to be the explosion that happens, a new low value for the weight of the neutron, 1.0006 mass units, has been calculated.

THE TRANSMITTABILITY OF ENCEPHALITIS

FURTHER research into the encephalitis which was epidemic in St. Louis this fall is now being done with monkeys, following the close of experiments on convict-volunteers in Mississippi.

Results of the studies on the monkeys carried on by Drs. Ralph S. Muckenfuss and H. A. McCordock, of Washington University School of Medicine, and Dr. Charles Armstrong, of the U. S. Public Health Service, have been announced by the health service in Washington.

Material from the brains of victims of human encephalitis has been injected into the animals, followed in almost every case by development of typical symptoms of the disease as it occurred in patients in St. Louis this fall. From 8 to 14 days after the injections the monkeys developed fever and sat hunched up with head bent forward and eyes closed as if asleep. When disturbed they seemed alert and often hyperexcitable.

The disease has been passed along from one group of monkeys to another by injecting material from the monkey's brain into healthy animals. Seven such transfers of three different strains of encephalitis have been successfully made.

Although the virus or germ causing the disease has not been gotten out into test-tubes and laboratory cultures, the fact that it can be kept alive in monkeys will enable the search to be continued and will possibly lead to the development of a means of fighting the disease more successfully than at present.

THE LABRADOR GOLD SURVEY

THE dream of prospectors that a goldfield rivaling the Klondike would be opened up in Labrador has been conclusively disproved by the findings during the past summer of Dr. A. K. Snelgrove, of the Princeton department of geology, leader of an expedition of Princeton undergraduates to Newfoundland.

One party of this expedition made discoveries of the greatest importance pertaining to intercontinental correlation in the field of geology.

Dr. Snelgrove, after a complete survey of a concession containing 42 square miles, alleged to contain over two billion dollars in gold, reported to the Newfoundland Government, which had authorized the survey, that the yield was not in excess of 40 cents to a ton. Last year the Newfoundland Government granted 22 concessions of 100 square miles each, in the area of Lake Wabush Katsao, 200 miles north of Seven Islands, Quebec, on the basis of a claim of gold ore found by Captain D. S. Bondurant, of St. Louis, Missouri.

When the government learned that these concessions were being publicly sold to speculators, it requested Dr. Snelgrove and F. W. Foote, a mining engineer from New York, to make the survey in the interest of the investors. The investigation was conducted under the supervision of the Honorable W. J. Walsh, Newfoundland minister of mines, and occupied three weeks. As a result of Dr. Snelgrove's findings, the Newfoundland Government withdrew its postoffice in the district and officially announced that the wealth of gold was a myth.

The Princeton expedition, which passed three months in Newfoundland, was divided into two parties. One party, conducted by George R. Heyl, graduate student at Princeton University, carried on operations along the northeast coast. In the Notre Dame Bay archipelago rocks were found which proved to be the exact counterpart of those occurring in Scotland. This discovery established a definite geological relation between the eastern and western hemispheres. Other finds made by this party furnished the key to the geology of the interior of Newfoundland.

The other party, led by John R. Cooper, also a graduate student at Princeton, has as its purpose the detailed mapping, with the aid of aerial photography, of the various differentiates of the blow-me-down mountain serpentines and their mutual relations on the west coast. This activity was planned by Princeton as part of a two-year program, designed to throw new light on the origin of intrusive rocks which have sprung from common magma.

Last summer's expedition was a continuation of a series of similar trips begun by Princeton in 1911. In addition to Dr. Snelgrove, Mr. Cooper and Mr. Heyl, three Princeton seniors, and one junior from Princeton University, accompanied the expedition. They were: Maitland S. Kemmerer, of New York City; John T. Smithies and James E. Quigley, of Chicago, and C. E. G. Reeves, of Summit, New Jersey.

REDUCTION OF CANADIAN BUFFALO HERD

BUFFALO meat will be available once more for homes, hotels and restaurants of this continent during November and December, following the decision of the Canadian Department of the Interior to reduce the government's buffalo herds at Buffalo National Park near Wainwright, Alberta, by two thousand head. This wholesale slaughter recalls the settlement of the western plains when hunters and settlers wiped out nearly all the buffalo of the plains, killing more than a million of the shaggy animals in less than twenty years.

This year's buffalo slaughter is necessary because of the increase of the herd at Wainwright to 7,500 head. There is only grazing room for about 5,000 animals at this preserve, where 25 years ago the Canadian Government took a herd of 716 animals. It is estimated that this original small herd has grown to 23,000 animals, including those moved to other preserves and those which have died naturally or have been killed off for meat by the government.

Strictly up-to-date methods are used in preparing the 1933 buffalo for the meat market. The whole herd is rounded up and the animals selected for slaughter are separated in special corrals. The buffalo hunt of older days has been replaced by a modern abattoir and the

animals are killed under the direction of government inspectors of the Dominion Department of Agriculture.

In pioneer days, when countless thousands of buffalo were killed only the tongues and part of the carcass surrounding the hump were utilized for food. Modern slaughtering methods have made possible many other choice cuts from the American bison, and a variety of steaks, chops and roasts will be on the market marked with government inspection stamps.

Not all the buffalo meat will be eaten fresh. A number of the animals will be used to supply food to destitute Eskimos and Indians in Canada's far north. The meat is dried and shipped to the northern police posts, where the constables will distribute it to families in want.

In the West buffalo robes and buffalo coats will be worn this year. Modern fur dressing methods have produced buffalo pelts superior to those which once were found in the homes of the early western settlers. And the Mounted Police will have a new supply of buffalo coats to wear on the Arctic trail.

Besides the herd of buffalo at Wainwright, Alberta, the Dominion has small herds at other western game preserves and a herd of approximately 15,000 animals in Wood Buffalo Park, at the boundary of Alberta and the North West Territory, where a 17,000 square mile reserve is maintained for the buffalo. Nearly 7,000 buffalo have been shipped in recent years from Wainwright to Wood Buffalo Park.

ITEMS

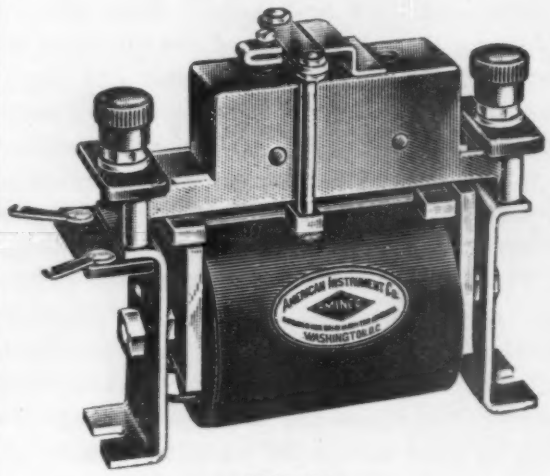
THE new cycle of sun-spots has begun. Dr. Seth B. Nicholson, of Mount Wilson Observatory, California, has observed two spots opposite in magnetic polarity to the old procession of gigantic disturbances on the sun that have held sway for the past ten and a quarter years. This was announced by the Carnegie Institution of Washington, of which the Mount Wilson Observatory is a part. One spot was seen the first three days of this week, while another very small one was observed October 10. It is now the time of sun-spot minimum. The sun was nearly inactive in July and August, slightly active in September and nearly inactive in October. The new family of spots now beginning will continue to troop across the sun's face for nearly eleven years.

CALIFORNIA is in for another winter with temperatures below normal and little rain. Thus Dr. George F. McEwen, Scripps Institution oceanographer, has interpreted the trend of weather-making factors off the West Coast, following his custom of the past several years, in which he has scored a high percentage of hits. He was right regarding both low temperature and scanty rainfall for the winter of 1932–33. The coming winter is not expected to be as chilly as last year's, though it will still be below normal in temperature averages. On the other hand, the precipitation trend indicates a drought even more severe than last season's. The values of the seasonal precipitation, as he has calculated them, range from 60 to 85 per cent. of the average.

GREAT wave-like disturbances far beneath the surface of the sea, that never show themselves at the top, are being studied by a noted Swedish oceanographer, Professor Otto Pettersson. He first noticed them while he was getting data on the salt content of the waters in the Kattegat, outlet strait between the Baltic and North seas. He found that the boundary between the salt water at the bottom and the fresher Baltic water at the surface was subject to great wave-like undulations, as much as two or three yards, although the tide changes at the surface were measurable in mere inches. Since his Kattegat observations, Professor Pettersson has found even greater submarine or internal waves, especially in partially landlocked waters. In Gullmarfjord, at the western end of the Skagerrak, they reach a height of over thirty yards. Professor Pettersson has found a twelve and a half hour cycle in these submarine wave movements, and also other cycles corresponding to various lunar periods. He has advanced the hypothesis that these internal waves depend on the vertical component of the moon's tide-producing force. Not all oceanographers are in agreement with him on this point, and the discussion of the cause of these internal waves is still in lively progress in scientific circles.

MOLTEN lava, so hot as to destroy in a moment any living thing it flows over, has nevertheless become a record book of ferns that once grew on the slopes of the great volcano Kilauea. The story of these "volcano fossils" is told by John E. Doerr, Jr., park naturalist of Hawaii National Park. One hundred and one years ago, a lava flow broke out on Byron's Ledge, a wall-like isthmus separating the craters of Kilauea and Kilauea Iki. The shallow streams of lava running down the wooded slope into Kilauea Iki destroyed all vegetation in their pathway, leaving them covered with black, shiny tongues of the hardened material. A recently made trail cuts through some of these century-old lava sheets, the thinner ones of which can be pried up in slabs. On the under sides of the slabs there are abundant hollow moulds of the stems and leaves of ferns, showing many fine details of their structure, even to the long narrow sori or fruiting bodies.

TYPEWRITER script can be read with almost the same speed and accuracy as the printed type produced by the linotype, Dr. Edward B. Greene found in tests conducted at the University of Michigan. Students, in ten-minute tests, read the linotype material a little faster than the typewriting when both were in 7-point size, but found the typewriting easier when in 10-point size, the "elite" size more commonly used in typewriters. The differences were so small, however, that linotype and typewriter script may be considered practically equal in legibility. It must not be assumed, however, that they would necessarily be equivalent for students not so advanced, for other kinds of type, or for longer periods of reading. The comparison of the two kinds of type was undertaken by Dr. Greene because the recent perfection of quick and inexpensive photoprinting processes in the printing of books and periodicals has made the question of legibility of typewriter type of increasing importance.



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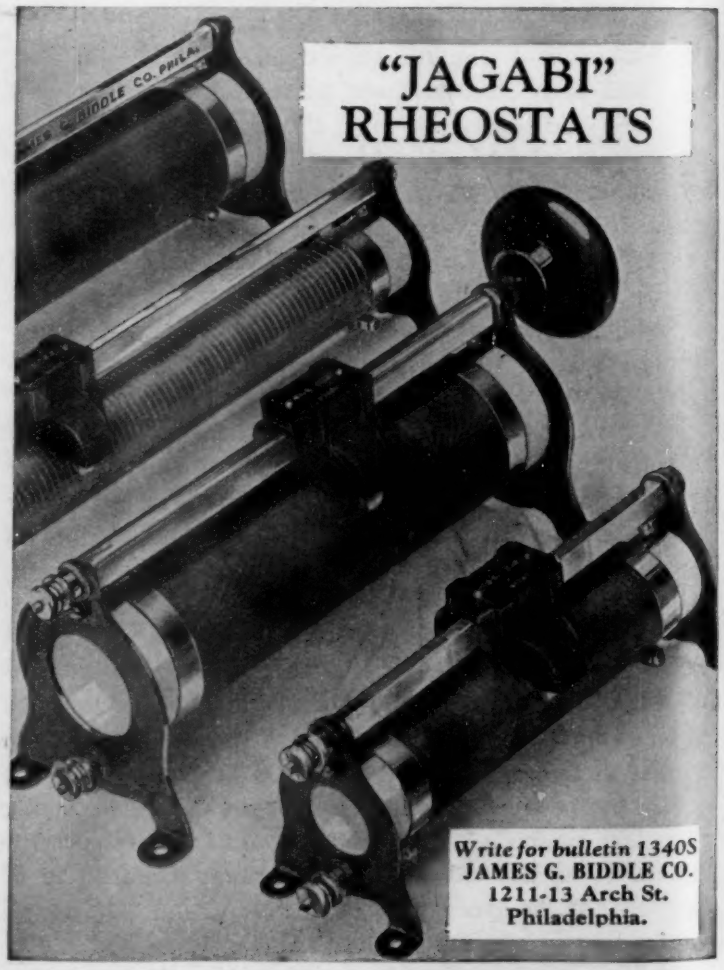

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SCIENCE NEWS

Science Service, Washington, D. C.

THE AWARD OF THE NOBEL PRIZES IN PHYSICS

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THREE European leaders in the new physics will receive the 1932 and 1933 Nobel prizes in physics. Professor W. Heisenberg, of Leipzig, was awarded the 1932 Nobel prize in physics for his development of quantum mechanics and its resultant discovery of the allotropic forms of hydrogen. The 1933 Nobel physics prize is divided between Professor E. Schrödinger, of Berlin, now working at Oxford, and Professor P. A. M. Dirac, of the University of Cambridge, England, for their new forms of atom theory. The 1933 Nobel prize in chemistry will not be awarded this year. The three relatively youthful European physicists who have been crowned with Nobel prizes in physics are the creators of physical theory that has had great influence upon philosophical ideas as well as science.

Professor Werner Heisenberg, awarded the 1932 Nobel physics prize, is now only thirty-two years old. Still younger is Professor P. A. M. Dirac, who is thirty-one years old, while Professor Erwin Schrödinger, formerly of Berlin and now of Cambridge, who shares the 1933 physics Nobel award with Professor Dirac, is the senior member of the group with an age of forty-six.

The three Nobel prize men, two Germans and an Englishman with a French name, all have picturesque personalities and their erudite adventures in physics, pursued in both European and American centers of research, have been accompanied by happy companionship among the trio and with other students of physics.

Professor Heisenberg is the son of a professor of Greek philology. He studied with Professor Arnold Sommerfeld and Professor Niels Bohr. By the time he was twenty-one he had an international reputation for his studies of atom structure and the Zeeman effect. His great achievement, the development of quantum mechanics, began in the fall of 1925. Then the young Heisenberg presented the scientific world with the first mathematical exposition of why the electrons revolving about atomic hearts stick to their orbits.

The famous Heisenberg principle of indeterminance or uncertainty was a further development of his theory. This proves that in the attempt to determine the velocity and the position of an electron science meets with a final boundary to human knowledge.

The citation of the Nobel award to Professor Heisenberg states that it is for his development of quantum mechanics "and its resultant discovery of allotropic forms of hydrogen." A colleague of Professor Heisenberg, then of the Kaiser Wilhelm Institute of Berlin, demonstrated experimentally the two molecular arrangements of varieties of ordinary light weight hydrogen (atomic weight 1) which are known as parahydrogen and orthohydrogen.

To a large extent the work on atom theory for which the 1933 physics Nobel prize is divided between Professors Schrödinger and Dirac is built upon the foundations of Heisenberg's work. The French physicist, de Broglie, who also received a Nobel prize, conceived the idea of the wave mechanics brand of physics which was carried on by Professor Schrödinger, who arrived at a shorter and simpler solution by a different route. Professor Dirac was doing his graduate work at Cambridge when Heisenberg's first paper was published in the autumn of 1925. Developing his own mathematics, using unconventional methods of getting clear of mathematical tangles, as exemplified by his invention of "q numbers," Professor Dirac produced a still more advanced system of quantum mechanics. Perhaps his most strikingly original and successful contribution is his relativistic theory of the electron. When just over thirty years of age, Professor Dirac was appointed to the Lucasian chair of mathematics at Cambridge.

Although until recently the Vienna-born Professor Schrödinger held the chair of theoretical physics at the University of Berlin, to which he was appointed in 1927, he now finds working at Oxford more congenial than the present atmosphere of Berlin. He made an enforced departure from Germany due to the present political régime, and last month he was elected to fellowship in Magdalen College, Oxford.

MATHEMATICAL EQUATIONS IN QUANTUM MECHANICS

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SEEKING to link the extremely minute realms of the new quantum mechanics of physics with the wide-flung scope of the mechanics of relativity, Sir Arthur Eddington, the Cambridge astronomer, presented to the Royal Society of London new mathematical equations which may receive acceptance by the scientific world and thus extend man's understanding of the physical world about us.

To obtain tractable equations in linking microscopic quantum mechanics and microscopic relativity, Sir Arthur found it necessary to use something mathematically simpler than the kilogram as a comparison standard of mass. As an intermediary, therefore, he uses an ideal uniform distribution of matter which he described as a sort of ether.

The link between quantum mechanics and relativity is given by a quadratic equation that, translated into words that can be set in newspaper type, reads: Ten times the letter m squared minus 136 the letter m times the letter m subzero plus the letter m subzero squared equals zero. The letter m is the mass of the electric particle and the two roots of the equation give the masses of the fundamental units of matter, the proton and the electron, found to be in the ratio of 1847.6 to one. The letter m subzero is the mass of comparison of the ether and it is calculable from a formula in terms of the following four fundamental constants: Planck's constant, the velocity of light, the de Sitter radius of empty space time and

the number of particles in the universe. This number is equal to ten raised to the seventy-ninth power.

In the maze of connections between physical constants developed by Sir Arthur this number of particles in the universe is the one pure number which has as yet no theoretical explanation.

One result of the equation that can be tested by observational astronomy is that there is a limiting speed of recession of the nebulae or the so-called red shift or Doppler effect. This limit is computed by Sir Arthur as 780 kilometers per second per megaparsec. This is a sort of upper speed limit for the explosion or expansion of the universe.

Sir Arthur Eddington, widely known as the author of "The Nature of the Physical World" and other books as well as for his scientific work in astronomy and theoretical physics, has in the past few years been developing a theory of the electron that can be reconciled with the relativity theory of Einstein, which incidentally Sir Arthur by his 1919 eclipse expedition did much to bring to the attention of science.

ALUMINUM-COATED MIRRORS AND ULTRA-VIOLET LIGHT

STARS that are hotter and brighter than science ever conceived, which make our own sun-star look like a candle beside a powerful beacon, have been "captured" in the aluminum mirrors of the Boothroyd expedition, just returned to Cornell University from a mountain peak in Arizona. For the first time, the ultra-violet spectra of about 80 stars have been photographed, opening up an entire new field to astronomers in the study of stellar matter and stellar temperatures.

This feat was accomplished as the result of a new process developed by two young Cornell physicists, by which chromium and aluminum can be deposited on glass. The silver-coated mirrors hitherto used in reflecting telescopes have been able to capture the spectrum only as far as the yellow-green region, and were unable to catch the high wave-length of the violet emanations, which tell more than anything else about the temperature and condition of the stars.

Professor S. L. Boothroyd, head of the Cornell department of astronomy, who organized the expedition to Arizona to put the new invention to practical test, reported on his return that not only did their spectrograms confirm previous ideas on the hotness of certain stars, but indicated that some of the so-called "dim" stars are in reality brighter, photographically, than those hitherto considered the brightest.

These tremendously hot stellar bodies are called "blue stars," as contrasted with red and yellow stars. They are dim, if not wholly invisible, to the human eye, because their ultra-violet rays escape the eyesight. The aluminum-coated mirror, however, proved much more effective than the human eye.

The Cornell investigators were given cooperation by the Lowell Observatory at Flagstaff, Arizona, and made use of the observatory's mountain station, 11,500 feet above sea-level on Schultze Peak, some ten miles north of Flagstaff. This location was chosen because of the clearness of the atmosphere and the comparative absence of dust, which absorbs much of the ultra-violet spectrum at lower levels. The expedition worked for about six weeks, taking pictures which have now been brought back to Cornell for study. About a year will be required for the detailed measurements and interpretation of the 200 spectrograms which were taken.

Professor Boothroyd's companions on the expedition were Robley C. Williams and G. B. Sabine, who, at his suggestion, developed the aluminum mirror. Their first success was with chromium, but aluminum proved even a better reflector. The mirror which did most of the work at Flagstaff was 15 inches in diameter.

"We obtained spectrograms of a region about as far beyond the violet," Professor Boothroyd said, "as the violet is from the yellow-green." Among the stars to which particular attention was given and which are expected to reveal valuable secrets about stellar composition were iota Orionis, Betelgeuse, Procyon and Rigel.

The Arizona experiments proved that high humidity of the atmosphere does not affect the transmission of ultra-violet rays; in fact, it does not even scatter them, as was previously suspected. The only thing that interfered with the work was dust and smoke, which seemed to keep the rays from coming through to earth.

Professor Boothroyd said that transmission was perfect after a rainstorm, when the atmosphere held a large amount of water in gaseous state. But when a windstorm blew up, filling the air with dust from the surrounding desert, results were extremely poor.

Some of the work was done at the Lowell Observatory, whose altitude is 7,350 feet. The astronomer noted the fact that there was practically no difference in transmission of the violet rays at that altitude and at the mountain station, which is 4,150 feet higher.

A DELICATE TEST FOR LEAD

LEAD, a poison against which our food, drugs and cosmetics have to be guarded with ever-increasing vigilance, is now made to betray its presence by the red blush it causes in a greenish solution of one of the aniline dyes, diphenyl-thio-carbazone, called "dithizone" for convenience by the chemists. The new test, which has the double advantage of being both delicate and quick, was described before the meeting of the Association of Agricultural Chemists by H. J. Wichmann, of the Food and Drug Administration, U. S. Department of Agriculture.

Food and drug analysts often have to determine whether or not a shipment of fruit is carrying more than the tolerated minimum of lead-spray residue. They can not take more than a few hours for this. Yet hitherto the quickest accurate lead-determining technique demanded several days. To deliver themselves from this dilemma they made their search for a new and quicker method.

The dye "dithizone" has been known for a long time; it was first described in Germany by the famous chemist Emil Fischer. Fischer even noted the red precipitate caused by the addition of lead. But so far as is now known, nobody had previously discovered the beautifully delicate gradations of color, from the solution's original

green through blue and purple to cherry red, that occur when a lead solution treated with ammoniated cyanide is added to a solution of the dye containing chloroform. By matching hues with other tubes containing a known amount of lead-dithizone, the chemist can now determine in a very short time exactly how much lead an "unknown" sample contains. The error involved in this operation has been determined as within four per cent.

The dithizone reaction is practically specific for lead. If the suspected sample contains tin or thallium, there may be some interference; but these elements can be eliminated in preliminary steps. A modification of the method, using formic acid instead of chloroform, gives promise of yielding equally accurate determinations for mercury, another poison frequently encountered in food and drug work.

Dithizone has hitherto been manufactured only in Germany, and is exceedingly expensive, the cost of the pure product delivered in this country being about $400 a pound. However, chemists at the University of Maryland have undertaken its manufacture, and have already succeeded in making enough of it for all official needs.

AMEBIC DYSENTERY IN CHICAGO

PHYSICIANS throughout the country are warned to be on the lookout for cases of amebic dysentery among their patients who visited Chicago this summer and fall. This warning was sent at the suggestion of Dr. R. R. Spencer, of the U. S. Public Health Service, who is assisting Chicago's health commissioner, Dr. Herman N. Bundesen, in an investigation of the dysentery outbreak in that city.

Some of the cases were not recognized as dysentery and the patients have been operated on for appendicitis and ulcerative colitis with unfortunate results. This is because the disease for the most part only occurs in tropical countries and is generally not thought of by physicians practising in the north.

The outbreak, which started early in July, has been traced to chronic cases and carriers of the disease among the food handlers in two Chicago hotels, according to the Federal Health Service. Reports of 113 cases have already been received. Of these, 79, including 7 deaths, occurred in Chicago, while 34, with 8 deaths, occurred outside Chicago, but have been traced to the Chicago hotels where the patients had been guests. Among the fatal cases were several members of the executive committee of the National Lumber Manufacturers' Association.

Health officials do not foresee any wide-spread outbreak of the disease throughout the country. But they are anxious to have all cases recognized as dysentery so as to avoid any further deaths due to mistaken diagnosis and wrong treatment, such as surgical operation.

Amebic dysentery is caused by a single-celled animal called ameba. It may be spread by contaminated water or foods that are eaten raw or by carriers who handle food, as in the Chicago outbreak. Cooking kills the ameba. The disease takes about three weeks to develop after the patient has been infected.

ITEMS

A NEW chemical preparation that can be used instead of thyroid extract for the treatment of one type of thyroid gland disorder will be announced by Dr. A. B. Anderson, of University College Hospital, Professor C. H. Harington, of London University, and Professor D. M. Lyon, of Edinburgh University, in the forthcoming issue of *The Lancet*. The new preparation has the scientific name 3-5-diiodothyronine. It has been used successfully in the treatment of myxedema, a condition due to underactivity of the thyroid gland characterized by dropsy-like swelling especially of the face and hands, dulling of mental activity, drying and wrinkling of the skin, falling hair and general sluggishness. Daily doses of the new medicine relieve the symptoms of this disease without producing any ill effects. It is given by mouth and produces results comparable to injections of thyroxine, the thyroid gland preparation generally used to treat this condition.

TINY colonies of leprosy bacilli, appearing under the microscope as groups of very small, red-stained rods and probably representing a further step towards the conquest of leprosy, were described by Drs. Earl B. McKinley and Elizabeth Verder, of the George Washington University School of Medicine at a meeting of the American Society of Tropical Medicine. These bacilli, generally considered to be the germs that cause leprosy, are so small that whole colonies of them can hardly be seen without the aid of a microscope. They are important because they have been grown outside the body of man or other animal. This means that scientists may at last be able to study them in laboratories like the germs of other diseases which have finally been conquered by such scientific investigations. These little bacilli, which were obtained from the bodies of lepers, are extremely difficult to locate, because even colonies of them are so fine and small they are easily missed by trained bacteriologists. The method which Dr. McKinley and Dr. Verder have developed for finding them, however, may help to locate the germs in the early stages of the disease and thus aid in its diagnosis.

EEL grass, a marine growth important as food for certain aquatic birds, is apparently disappearing from European waters as well as from the Atlantic seacoast of North America, as recently reported. A. D. Cotton, keeper of the herbarium and library of the Royal Botanic Gardens at Kew, reports in *Nature* that the plant is almost gone from many places in England where it was formerly abundant, and that in other places only a few scattered undersized specimens are to be seen. The disappearance of the eel grass can have serious consequences aside from the distress and starvation it causes among waterfowl, for the plant is in many places the means of holding mud and sand banks stationary, which now, without its anchoring action, can be washed out by waves and currents, causing serious trouble by being redeposited in navigation channels.

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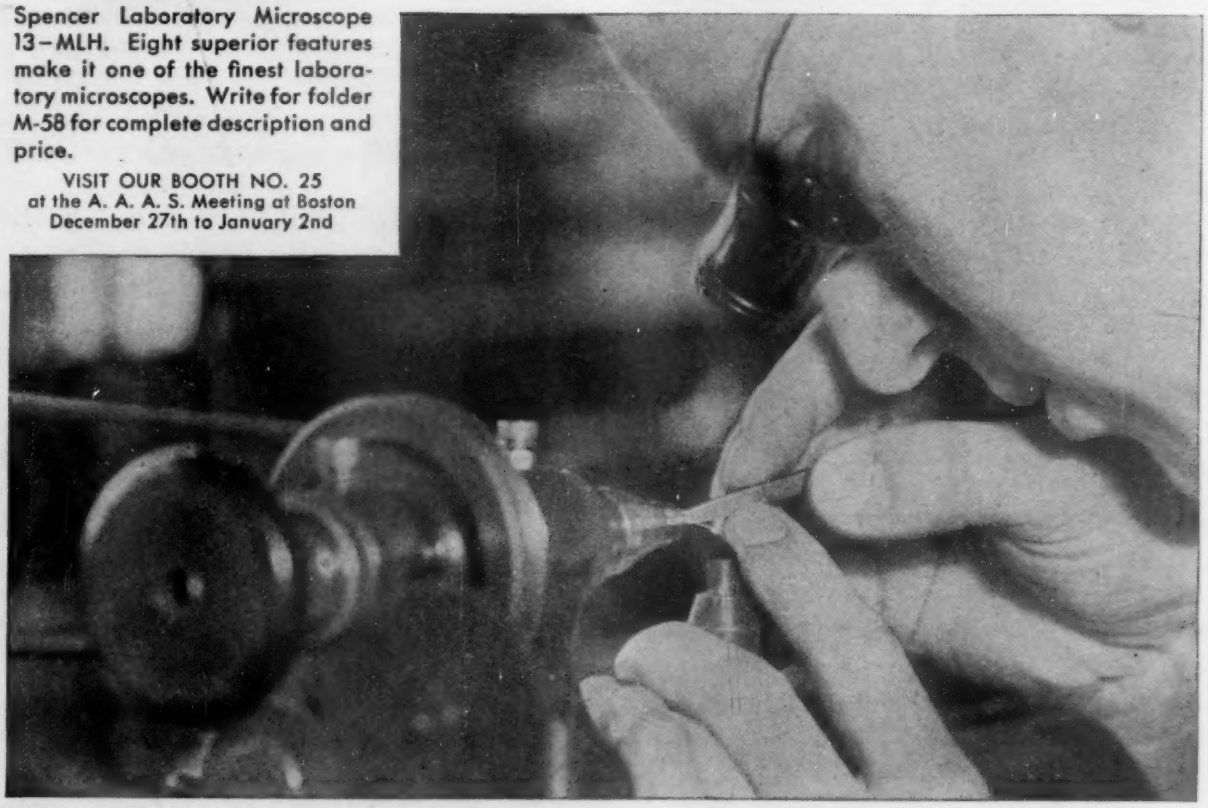

SCIENCE NEWS

Science Service, Washington, D. C.

THEORIES OF THE UNIVERSE

WORLDS are, because parts of the universe collapsed. This, in a sentence shorter than a telegram, sums up a theory of the genesis of the spiral nebulae, the vast islands of suns that swim at vaster distances apart in the depths of space, as presented by the Abbé Georges Lemaître, of the University of Louvain, before the Washington Academy of Sciences.

The Abbé Lemaître, who is at present a visiting professor at the Catholic University of America, developed this theory as a part of his larger theory of an expanding universe, which started with all matter (or energy) concentrated at a point, and which has been rushing asunder with explosive speed ever since.

The universe, the lecturer reminded his hearers, is exceedingly empty. The masses of the stars, and of their aggregations into galaxies, are impressive; but when all matter is averaged out into all the space through which it is distributed, it comes to about one atom to a cubic yard of space. How could so thin a population of particles ever become aggregated into whole galaxies of suns?

For answer, the Abbé postulated regional irregularities in his expanding universe—regions where the rate of expansion was slowed down to a certain critical low velocity. In some of these regions, the velocity of expansion failed to accelerate again; there were "collapses," permitting the aggregation of particles, and their condensation into the spiral nebulae or galaxies.

Abbé Lemaître suggests that such a moment of critically low velocity of expansion, with resultant collapse and formation of aggregates of matter, occurred for the odd millions of light-years of space with which we are familiar about a billion years ago. This billion years is much less time than is called for by the theory of the passing of all stars through the same stages of development, from giant globes of unimaginably hot gases to aged "dwarf" stars of relatively feeble temperature energy. The Abbé does not think it necessary to postulate this uniform evolutionary course for all stars; his theory admits of the simultaneous and very rapid formation of stars of all classes. His contacts with American astronomers on his present visit to this country, he said, have supplied him with data which appear to support his present theory.

A VERSATILE SOLVENT

ONE dream of the ancient alchemists, the "universal solvent," has been brought nearer to realization than ever before by the discovery that acetamide, a compound made from acetic acid and ammonia, has a wider range of solvent power than any other known substance. This discovery has just been announced by Professor O. F. Stafford, of the department of chemistry at the University of Oregon.

Because all life processes occur in solution, and because many important industries are dependent upon solubility relationships, Professor Stafford's discovery is regarded by his colleagues as an outstanding contribution to the science of chemistry, both in its pure and applied aspects.

The best common solvents hitherto known have been ammonia and ordinary water; acetamide is declared to be superior to both. To test his discovery, Professor Stafford ascertained the approximate solubilities of some 400 organic and 200 inorganic substances. Working on the theory that a substance is most soluble in another substance chemically related to it, he found that acetamide has such chemical kinships to an unusually wide range of other substances. That is, each of the atom-groups in its make-up reaches out, like a hand, toward similar atom-groups in many other compounds. It is this fact which gives it its extraordinary solvent powers.

Acetamide contains a methyl group that gives it solvent powers for hydrocarbons; its carbonyl group relates it to ketones, esters and acids; its tautomeric hydroxyl group gives it kinship to water and the alcohols; its amino group brings it into line with ammonia and its derivatives, while the ease with which it yields nitrile suggests a relationship to cyanogen compounds.

Acetamide has long been known to chemists, though its extraordinary solvent powers have only just been discovered. It is a solid at ordinary temperatures, but it melts at about 80 degrees Centigrade (176 degrees Fahrenheit) to form a mobile liquid. It is easily and cheaply manufactured from acetic acid (the stuff that makes vinegar sour) and ammonia. Its ability to dissolve many things, at present nearly or quite insoluble, is expected to lead to important industrial applications.

Professor Stafford is already well known in his field, especially for the invention of a process of wood carbonization, which is in large-scale use at an industrial plant at Iron Mountain, Michigan.

THE RESISTANCE OF REGENERATED CELLS

A NEW theory of how certain cells of the body develop resistance to injury was described by Dr. William deB. MacNider, of the University of North Carolina, at the meeting of the Southern Medical Association. For the scientific studies leading to the development of this new theory, Dr. MacNider was awarded the research medal of the association.

The new theory may explain what happens to some patients suffering from chronic Bright's disease and to mothers who develop kidney trouble just before the birth of a child.

Certain cells of the kidneys and liver, known as fixed tissue cells, can be injured by such poisons as bichloride of mercury, uranium and chloroform. Dr. MacNider investigated the results of such injuries in animals and found two types of reaction.

In one type the injured cells may regenerate or "come back" in a form similar to their original cell form. These cells, he found, had no resistance to future injury

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by the same chemicals. On the other hand, the cells may regenerate or come back in a changed form which is not the normal type of cell, but which is capable of doing some work. This type of cell is resistant to many times the amount of the same injurious chemical that produced the change.

Dr. MacNider observed dogs that developed acute Bright's disease from bichloride of mercury or uranium poisoning. When the animals were slightly ill and then recovered, with no change in the type of cells in the kidneys, they had no resistance to further poisoning with the chemicals. But when animals became very ill and recovered, their kidneys having been repaired with an abnormal type of fixed cells, they developed a very great deal of resistance to the chemicals.

From these studies, Dr. MacNider concluded that the mother who is very ill of kidney disease before her child is born, but who recovers, can generally have more children without any further trouble, because the cells in her kidneys have come back in this abnormal, highly resistant form. On the other hand, the patient who is only slightly ill will probably have trouble before the birth of subsequent children.

THE OVER-PRODUCTION OF INSULIN

A CONDITION which appears to be epilepsy, but is really due to the increased production of insulin and consequent greatly decreased amount of sugar in the blood was described by Dr. W. McKim Marriott, of the Washington University School of Medicine, St. Louis, to the Southern Medical Association.

One case occurred in a year-old infant who had repeated convulsions, like those of epilepsy, and whose mental development was retarded. His blood had about half the normal amount of sugar. Tumor of the pancreas, the organ which contains insulin-producing tissue, was suspected, but not found. Finally a St. Louis surgeon, Dr. Evarts Graham, operated and removed nearly seven eighths of the pancreas.

This is said to be the first time so large a portion of the pancreas has ever been removed as a curative measure. After the operation an enormous amount of sugar appeared in the blood. At the end of a week, however, the amount had returned to normal and remained so, and the convulsions stopped.

This condition of over-production of insulin is just the opposite of diabetes. Sometimes it occurs in diabetic patients who get an overdose of insulin. The patient has an "all gone" feeling, and there may be numbness, mental confusion and incoherent speech. The patient may appear to be drunk. Dr. Seale Harris, of Birmingham, Alabama, was one of the first to report this condition and to suggest that it was due to overproduction of insulin.

Dr. Marriott said that a tendency to this condition is especially common in infants and young children. In infancy the symptoms are irritability, colic and continuous crying; in older children, emotional excitement, undue sensitiveness, fatigue and often periodic attacks of vomiting.

When the epilepsy-like convulsions occur, it is generally in the early morning, when there has been the longest period of time without food. Injecting sugar into the veins greatly relieved the symptoms, and in some cases feeding sugar at midnight was especially helpful. In a number of cases, however, operation to remove a tumor of the pancreas or a portion of the organ itself was necessary.

Dr. Marriott described other ailments which occur as a result of disturbance of the chemical composition of the blood and told the assembled physicians that in practising medicine, "it often pays to be chemically minded."

FURTHER STUDY OF PALESTINE CAVE DWELLERS

AT the Royal College of Surgeons, London, eminent investigators have started examination of twelve important skeletons, representing adults and children who lived in caves of Palestine more than 50,000 years ago.

The bones of these early inhabitants of the earth were discovered by Dr. Theodore McCown, of Berkeley, California, who excavated caves of Palestine with a joint expedition from the American School of Prehistoric Studies and the British School of Archeology in Jerusalem.

Removing the skeletons from the solid blocks of limestone and breccia, in which they have been shipped complete to London, is expected to require two years. The bones will have to be drilled out with delicate pneumatically operated chisels.

Sir Arthur Keith, the well-known British anthropologist, is supervising the project, and Dr. McCown is taking direct charge of the task.

One of the skeletons will, by requirement, be returned to Palestine to the custody of the antiquities department of the government there. Of the remainder, half will be sent to America and the rest will remain at the College of Surgeons.

When discovered, the skeletons from Palestine attracted wide scientific notice, because they appeared different from the type of men previously known to exist in the Mousterian period of the Old Stone Age. The Neandertal type that lived in Europe then was a slouching person with beetling brows, low forehead, and no chin to speak of. The new discoveries indicate that most of the Palestine cave men had well-developed chins and higher foreheads. Sir Arthur Keith called the Palestine men a new race, and suggested the name *Paleoanthropus palestinus*, or the Old Man of Palestine.

It has been suggested, however, that when the skulls are removed from their stony matrix they may turn out to have chins more receding than appears in their partly obscured condition. Hence, the examination of the skeletons is awaited to show whether or not science has discovered a new ancient race of man.

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Tables of Numerical Values included in the work are as follows: The quantity $\sqrt{(a^2+b^2)}/a$ for different values of b/a, three decimal places; Trigonometric Functions, four decimal places; Radian Measures of Angles; Logarithms to Base 10, four decimal places; Natural Logarithms, four decimal places; Exponential and Hyperbolic Functions, five significant figures; Complete Elliptic Integrals of the First and Second Kinds, four significant figures, with columns of differences; Bessel Functions—Tables for ber, bei, ker, kei and their derivatives to the fifth order of the functions; Gamma Function, five decimal places.

Numerous references are included which will be helpful in showing where the derivation of results is given or where further similar results may be found.

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greatly increased, thanks to the innovations brought about in the present type of radio range-beacon by F. W. Dunmore, of the Bureau of Standards.

The system makes possible the sending of four different signals in four directions, namely, one dot in a westerly direction, two dots east, three dots north and four dots south. By noting which signal is the loudest the pilot may determine his general direction.

With the radio beacon now in general use the determination of absolute direction or position on airways is difficult because the same signal is sent to four points of the compass. When the aircraft is near the radio beacon a pilot may pass from one course to another without knowing it. If lost it may take him an hour to reorient himself and the danger in case of shortage of fuel or the importance of time lost when on an errand of mercy will be apparent. It is believed by the inventor that the present scheme obviates these difficulties admirably.

The method consists of changing the so-called figure-of-eight transmission for the courses to the unidirectional cardioid transmission by changing the point of coupling into suitable phasing sections in the transmission line feeding the antenna, or, by superimposing on a figure-of-eight radiation through a suitable hybrid coil circular radiation in phase with the figure-of-eight direction.

The method has been tried out extensively at the bureau's experimental field at College Park, Maryland, and has been found altogether satisfactory. No additional equipment is required for receiving the signals on aircraft.

ITEMS

THE uncanny power of ultra-violet rays, to detect what is hidden from ordinary eyes, is now turned on the farmers' seed. Tests at Queens University, Belfast, show that ultra-violet light reveals differences in the grade of seed that are not shown up in ordinary light. The experiments were conducted by P. A. Lineham and S. P. Mercer. Rye-grass seed used in the tests were found to be fluorescent when inferior in grade. The type which is superior for farming uses was found to be non-fluorescent. The two kinds of seed are usually mixed or hybridized in stocks of rye grass when it is planted for pasture. The same test has also been applied to distinguish varieties of wheat and barley and to find the relative vitality of seed potatoes.

A NEW highway, recently completed, from Tower Falls to Mammoth Hot Springs in Yellowstone National Park, brought to light in a rock cut two petrified tree stumps. Both are upright, standing in the position in which they grew millions of years ago. In the process of road building they have been nicely halved and left embedded in the solid rock, rock which was probably volcanic dust at the time petrification was taking place back in the Miocene. Their root systems may even be traced with a little patience and a great deal of care. It is not known what kind of trees these were—they may have been chestnuts, sycamores, sequoias, pines or cypress, for all grew here at one time or another during the centuries fossilization was in progress.

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W. J. CROZIER JOHN H. NORTHROP W. J. V. OSTERHOUT

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SCIENCE NEWS

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COSMIC RAYS

COSMIC rays are probably the hearts of atoms of ordinary matter, positively charged by the action of starlight on interstellar gas, and accelerated in some cosmic or possibly terrestrial electric field.

Ten thousand observations of cosmic-ray intensities just completed in Panama and Peru and earlier studies in this country and Mexico have led Dr. Thomas H. Johnson, of the Bartol Research Foundation of the Franklin Institute, at Swarthmore, Pennsylvania, to this conclusion, which is contrary to other theories of cosmic ray formation.

Using a sort of cosmic ray "telescope" that "sees" on a motion picture film only the cosmic rays that pass through three-in-line Geiger-Mueller counting devices and set off in them simultaneous electrical pulses, Dr. Johnson has now definitely established that the western sky is "brighter" with cosmic rays than the eastern sky. If our eyes could see the cosmic ray corpuscles as they do the waves of ordinary visible light, they would see more cosmic ray light in the west. This difference in cosmic ray brightness between the east and west is also greater at higher elevations and the closer the observer goes to the magnetic equator.

Dr. A. H. Compton, of the University of Chicago, Nobel laureate in physics, and Dr. J. Clay, a Dutch physicist, have shown by their researches that the total intensity of the cosmic radiation decreases towards the magnetic equator. The lower equatorial intensities were readily explained by the supposition that part of the primary radiation consisted of electrified particles, but these studies could not determine whether the electrical charges were positive or negative. By the same physical laws that make it possible to determine which way the electric current is flowing in the wires of a motor from the direction in which its armature rotates, it is also possible to determine whether the charges of the cosmic rays are positive or negative from the way their paths are bent by the magnetic field of the earth. The fact that they are bent towards the east and therefore enter from the west means that the rays are mostly positively charged as any high school physics student can verify. This fact was first indicated a year ago as a result of Dr. Johnson's studies on Mount Washington, New Hampshire.

His most recent work on the equator in Peru now gives him data which allow him to conclude that all the cosmic ray corpuscles in the energy range which is affected by the earth's magnetic field in equatorial latitudes are positive and that there are no negative rays. The fraction of the total radiation which now can be directly attributed to the electrified radiation is also much higher than had been supposed previously. In fact these measurements show that at least forty per cent. of the total radiation is of this nature.

Most of the rays which are actually observed are known to be of secondary origin produced in the atmosphere by the bombardment of the primary radiation. These secondary rays are positively and negatively charged corpuscles in about equal numbers, as Dr. Carl D. Anderson, of the California Institute of Technology, has shown, but since their directions of motion are the same as those of the primary rays it is possible to use their directions as an indication of the directions of the primary rays before they enter the atmosphere.

THE TEMPERATURES OF THE STARS

THE photographs that are made of the stars when a spectroscope is used in conjunction with a telescope show gradations in character as well as in brightness. These gradations have long been known to indicate the temperatures of the star's surface. Only recently, however, has it been learned how to read the actual temperature from these so-called star spectra. The method has been worked out by Professor H. N. Russell, of Princeton University, in conjunction with the Mount Wilson Observatory.

We must be satisfied with surface temperatures, Professor Russell explains, because we can look into a star only through a small mass of its atmosphere. If our atmosphere were as opaque as the hot atmosphere of a star, we could see only a few feet in it. The opacity is due largely to the abundance of free electrons and ions which are partly separated from each other on account of the high temperatures. The extent of this so-called ionization can be calculated according to the law of mass action which has proved so powerful in studying chemical reactions.

The extent of the ionization also determines the character of the spectrum. Professor Russell described how certain lines in the spectrum at first became stronger as the temperature increased and then became weaker again. By studying the relative strength of many lines he tells how hot is a star. By this method he expresses in degrees the temperatures of many stars which have previously been classified only as to color.

Using this information Professor Russell is able to determine the relative abundance of different elements in the stars. It turns out that hydrogen, for example, is usually a thousand times more abundant than all the metals put together. The fact that hydrogen is not preponderant on the earth indicates that it has escaped because of its lightness.

THE AGE OF THE EARTH

UNCERTAINTIES in estimates of the earth's age are being clarified by determinations of the leakage of helium through geologic rock materials. The modern geologist's estimate of the earth's antiquity is 3,000,000,000 years. But the two methods used do not always agree. Work reported to the *Journal* of the American Chemical Society by Dr. William D. Urry, of the Massachusetts Institute of Technology, now settles some of these uncertainties.

The helium method of determination of geologic time depends on the amount of helium in rocks. Helium, the

second lightest gas, first discovered in the sun and now used for filling airships, is split off when one radioactive metal changes into another. Knowing that radioactive decay goes on at a constant rate, it is possible to find the proportion of helium in a rock and compute its age.

But if the helium generated within the rock leaks out of the various metals, estimates of the age with this method will be too low. To determine the rate of this leakage Dr. Urry has placed helium in iron and bismuth containers and measured the loss after it had been subjected to various treatments. He found that there was no appreciable leakage.

Since many rocks are composed largely of quartz a single large crystal of quartz was tested. This also showed no loss. Various glasses, however, do allow the passage of helium. If the helium is free inside a porous rock it will slowly diffuse through the pores. Dr. Urry has set up a mathematical expression to account for this leakage.

In determining the age of meteors by the helium method geologists have suggested that the material might pick up this gas in its passage through helium-filled space. The objection is overcome by Dr. Urry's work, which showed that steel did not adsorb helium.

The 3,000,000,000 year estimate of the earth's age is obtained from a different method. It is based on the conversion of the metal uranium into lead. The lead-uranium ratio has been used as the most satisfactory method of measuring geologic time. It is the purpose of Dr. Urry's work to bring the helium analysis figures into better agreement with the former method.

HEREDITARY CHANGES IN SEX-CELLS

WHEN the male of a white mouse is poisoned with alcohol or certain plant toxins, such as ricin, the sex cells are affected in a specific way. A true mutation, that is transmitted as a functional change in the animal's descendants, is caused. These observations have been reported by Dr. Agnes Bluhm, of the Kaiser Wilhelm-Institut of Biology in *Forschungen und Fortschritte*.

The change shows itself in the children in the fact that there is a greater mortality in their litters. If, however, the children of an alcoholized male are mated among themselves, the mortality rate is less in the grandchildren and may disappear entirely in the great-grandchildren. This fact would seem to indicate that the alcohol had simply a harmful effect which was wiped out in two generations and had not produced a really hereditary characteristic.

Dr. Bluhm believes, however, that a distinct mutation is produced in the sex chromosomes of the male, which in interbreeding is obscured by the fact that in the fertilization of an egg by the affected sperm cell there is produced in the egg an antagonistic substance, something after the manner of a toxin-antitoxin reaction. The reason for this belief is based on the results of cross fertilization. When a male of the alcoholized strain is mated with a normal female the mortality in the young is always greater than when a female of the alcoholized strain is mated with a normal male.

When the male mouse was poisoned or immunized by gradually increasing doses of ricin, his immediate progeny showed hypersensitivity to small doses of ricin. Like the alcohol effect this physiological reaction tended to disappear in the successive generations, but its existence in the male cell could be brought out by cross fertilization. That the effect was specific for the ricin and not simply a general weakening or injury was demonstrated by testing the progeny with other poisons, snake venom, for example, or abrin.

It has long been known from the work of Muller and others that radiation of the sex organs with x-rays will produce definite mutations which express themselves in structural features of the descendants. Dr. Bluhm's work indicates that chemical reagents may cause similar mutations, which express themselves, however, in specific functional alterations in succeeding generations.

A NEW WEIGHT-REDUCING DRUG

ENCOURAGING results with the new weight-reducing drug which enables fat persons to lose weight while eating an ordinary diet have been obtained by Professor E. C. Dodds, of the Courtauld Institute, and Dr. J. D. Robertson, of the Middlesex Hospital, London. The results are to be announced in *The Lancet*.

The new weight-reducing drug has the chemical name of dinitro-ortho-cresol and is said to be five times more powerful than dinitrophenol, which American physicians have been trying out clinically. Both drugs act to cause weight reduction by speeding up the rate of metabolism, the process of tissue change constantly going on in the body and embracing the change of foodstuffs and tissue into energy for the body's use. When the metabolism is speeded up, the body uses up energy faster, calling on the reserve stores of fat to augment the daily food supply. As a result, weight is lost.

The thyroid gland is a regulator of the rate of this process, and when because of disease or some other condition, it fails to function normally and the rate is very much slowed up, the condition of myxedema results. Thyroid extract restores the rate to normal and relieves the symptoms. The new drug which stimulates metabolism also restores the lowered rate of myxedema patients to normal, but without relieving the patient of the other symptoms of the disease.

This suggests a new and interesting point: either the relief of myxedema is independent of the raised metabolic rate or else metabolism induced by medication differs from normal metabolism.

Dinitrophenol is a potent and dangerous substance, not to be used without a physician's direction. Deaths have already occurred from its indiscreet use. Dinitro-ortho-cresol is said to be safer than dinitrophenol, but it is not intended for use without medical guidance.

PREVENTABLE MATERNAL DEATHS

NEARLY two thirds of the mothers dying in childbirth could have been saved if they had had proper care, a committee of the New York Academy of Medicine has found in their three-year survey of maternal deaths in New York City.

Physicians were held responsible for three fifths of the

preventable deaths. The patients themselves were responsible for more than a third of these deaths and midwives for about two in every hundred.

Lack of judgment, lack of skill or careless inattention to the demands of the case were faults of the physicians that contributed to the large number of maternal deaths. The patients' fault was failure to take advantage of those facilities which are at hand for safeguarding them during and before the birth of children.

The committee believes that the number of deaths can be reduced by reducing the amount of surgical interference during the birth of the child. At present surgical procedures are resorted to four or five times oftener than actually necessary. The death rate when childbirth is assisted by operative measures is five times as high as in spontaneous births.

Comparing the number of deaths when the child is born at home and in a hospital, the committee found that the increase in hospitalization failed to reduce sickness and deaths among the mothers as much as had been hoped for. However, it was observed that only normal, uncomplicated births take place in the home, as a general thing.

Contrary to generally accepted opinion, the midwife is an acceptable attendant for properly selected cases of childbirth. The committee recommended provision for proper training and supervision of these assistants.

ITEMS

BIRDS are frequently so sensitive to climatic factors that slight differences in temperature or moisture will keep two related species separate, although their range boundaries touch and even overlap. An illustration of this principle, in the case of the two American species of magpie, was given before the meeting of the American Ornithologists' Union by Dr. J. M. Linsdale, of the University of California. The common black-billed magpie of the West has a wide range, extending roughly from the Missouri to northern and central California. Here it gives way to the much less numerous yellow-billed magpie, whose range is limited to the valleys of central and southern California and adjacent southwestern states. No insuperable physical barriers separate the territories of the two species. The only thing that keeps them from mingling is a slight difference in choice of climate on the part of the birds. Seasonal changes in climate work in such a fashion that in some places the two species occupy the same territory, but never at the same time. When it is moist enough for the black-bills to come down into yellow-bill country, it is too cold for the yellow-bills and they retreat toward the lowlands. Then, when it is warm enough for them to come back the drought is too much for the black-bills, which vacate before their cousins can return their call.

UP in the stratosphere twelve miles above the North Pole, proverbially a cold place, it is 25 degrees warmer than at the same height over the equator. Dr. G. C. Simpson, director of the British Meteorological Office, explained in connection with the results of the British Polar Year Expedition to Fort Rae, Mackenzie, Canada, that the cause of this greater warmth over the pole is not known. The curious fact that it is warmer over the North Pole than over the equator in the upper air has been studied at some length in the United States. Dr. Hurd C. Willett, of the Massachusetts Institute of Technology, in a report to the National Research Council some years ago observed that the higher the earth's atmosphere is probed, the colder it gets, until a point is reached where there is no more decline. Above this there may even be a slight warming. An explanation of this upper-air reversal of the temperature relationships at the surface of the earth involves, according to Dr. Willett, the way in which the sun's heat is received in the atmosphere and the mechanism of the general circulation of the atmosphere.

FERTILIZERS help plants to form more foodstuffs, but they do it by increasing the total area of the leaf surface and not by raising the efficiency of the individual leaf as a synthesizing unit. This conclusion was reached by E. Basyrina and V. Tchesnokov, of the plant physiological section of the Russian Academy of Sciences, as a result of their experiments with oats grown in culture solutions. Given varying rations of phosphorus, nitrogen and potassium, the plants responded by varying their leaf areas, but unless the leaves became deficient in chlorophyll, the amount of food formed by a given unit area did not change.

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SCIENCE NEWS

Science Service, Washington, D. C.

THE HIGH POTENTIAL STATION AT ROUND HILL

TEN million volts, the closest approach to the voltage of lightning, flashed across the gigantic ball terminals of the great generator erected by Massachusettts Institute of Technology physicists in Colonel E. H. R. Green's airship hangar at Round Hill, Massachusetts, recently, for the first time at its full designed electrical potential.

It is the opening report in an investigation of fundamental importance and it may have far-reaching consequences even in the commercial generation of electric power.

A few years ago there was a young Rhodes scholar at the University of Oxford. Puzzling over the problem of power for smashing the atom and studying its internal structure, Dr. Robert J. Van de Graaff went back to the idea of the old-fashioned static generator for electricity, the sort of electrical machine used by Benjamin Franklin.

Modern electrical generation had developed along the line of electromagnetism, and Dr. Van de Graaff revived the other principle and built it into a modern machine. He went to Princeton University as a National Research fellow, and built a small laboratory model of his generator at the cost of a few hundred dollars. It produced between 1,000,000 and 1,500,000 volts, the highest direct voltage current ever attained up to that time. Much more expensive apparatus, upon which other investigators had worked for years had been able to produce only 800,000 volts direct current.

Working with Dr. Karl T. Compton, then professor of physics at Princeton, Dr. Van de Graaff joined the staff of the Massachusetts Institute when Dr. Compton became president. With the aid of associates, they visualized a giant generator, the electricity-producing machine that in its tests has fulfilled their expectations.

No conventional building at the Massachusetts Institute of Technology was large enough to house the large Van de Graaff generator. Colonel Green offered his airship dock on his estate at Round Hill, Massachusetts, a structure 140 feet long, 75 feet wide and 75 feet high, with railroad track running into it and great doors that weigh over 23 tons.

The 10,000,000 volt Van de Graaff generator consists of two large hollow columns, 25 feet high and six feet in diameter, which are surrounded by a hollow polished aluminum sphere 15 feet in diameter. Each column is mounted on a heavy four-wheeled truck running on railway track 14 feet wide. The spheres, which act as reservoirs into which electricity is poured by relatively small static generators at the base of the columns, rise to 43 feet above the ground.

Even while the generator is running at full potential, it is possible to work within the 15-foot diameter aluminum spheres, surrounded by high potential electric fields in a manner somewhat analogous to the way in which Settle and Fordney were surrounded by rare air on their stratosphere flight and Beebe was surrounded by ocean in his record bathysphere dive.

The giant aluminum spherical terminals are unique in construction, the largest such structures of this metal ever produced. They were made by fabricating orange-peel sections which were welded and then polished to a bright finish so as to eliminate projections that would cause the electricity to spark away. Although built of light metal a half inch thick, each hollow ball weighs a ton and a half.

The spheres are charged with electricity by a process not unlike the old-fashioned method of raising water from a well by means of small buckets on an endless chain, each bucket dumping its load as it turns over a pulley at the top. Paper belts, four feet wide, convey upward the electrical charges sprayed upon them at the base at the comparatively low pressure of 20,000 volts. Or the generator can actually be operated without any artificial source of electricity, as it can draw the necessary electrical charges from the earth. When there is merely air between the two spheres, the direct current generated flows as a steady flashing stream, at designed peak a combined electrical pressure of 10,000,000 volts, with the oppositely charged spheres each at a potential of half that value.

When the real work of the Van de Graaff generator begins, there will be no spectacular electrical fireworks. A large vacuum tube, a foot in diameter and 40 feet long, designed by Dr. L. C. Van Atta, made not of glass, as is usual, but of laminated paper, will extend from one sphere to the other and the electricity will discharge through it, creating the most powerful x-rays ever known by hurling millions of electrical "bullets" against a metal target. Each of these "bullets" will be moving at velocities 100,000 times greater than the speed of any rifle bullet, a speed so great that they would encircle the earth's equator three times a second.

SUN-SPOTS AND RADIO RECEPTION

THE recent announcement of a few high latitude sun-spots carries special significance for the radio fan, for it announces that we have definitely marked the minimum in the present sun-spot cycle. Observations at the Perkins Observatory have shown that field intensities from Chicago station WBBM during the last two years have remained consistently at the highest level since the sun-spot maximum in 1928–1929. The present field intensities average about 2,000 microvolts in the observatory's antenna, a value fifty times greater than that measured at the beginning of the decline in sun-spot numbers.

The few spots that have been occasionally appearing during the present sun-spot minimum have shown a comparatively small effect on the radio as compared with the effect produced by the terrific solar cyclones which raged on the sun four and five years ago. Long-distance reception in the broadcast band has never been better than in 1932 and 1933 since the advent of broadcasting. Contrary to popular belief, however, this has not all been due to improvements in radio technique nor to the increased power in broadcasting stations. The fifty-fold

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EDITED BY J. McKEEN CATTELL

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increase in intensity can without doubt be attributed to quieting activity in the solar disturbances which are chiefly responsible for the ionization of the Kennelly-Heaviside layer.

The rise in the ionized layer during the last two years which has been responsible for the excellent long-distance reception has, however, had a somewhat disquieting effect on those who listen to programs thirty or forty miles from a broadcasting station, for the sky wave has come through so well as to interfere with the ground wave at these critical distances, thus producing interference and mushiness in receiving sets within this critical area. With the beginning of the new sun-spot cycle, long-distance reception during the next few years will deteriorate, but the disturbing factors just mentioned in local areas should become less troublesome. Radio fans therefore may expect to be compensated for their lack of DX reception by much improvement in the shorter range.

A careful analysis of recent behavior of sun-spots as studied at the Perkins Observatory reveals that no material change from the present radio conditions will be apparent until near the end of 1934. Conditions for transcontinental enjoyment of programs should therefore continue for another year. In addition to the measurement of the daily reception of WBBM, Chicago, at Delaware, the observatory has recently inaugurated nightly measurements of KFI, San Francisco, which should materially contribute to further knowledge of the behavior of the ionized layer with the coming rise in the sun-spot cycle.—*Harlan T. Stetson.*

PHOTOELECTRIC MEASUREMENTS OF THE SIZE OF NEBULAE

DR. JOEL STEBBINS, director of the Washburn Observatory of the University of Wisconsin, predicted in a lecture on November 28, at the Carnegie Institution of Washington, that new photoelectric measurements of the size of nebulae and the effect of dark, obscuring matter in interstellar space will greatly reduce astronomical estimates of the size of the Milky Way galaxy of stars in which our sun is a minor star and the earth a speck of dust.

Our galaxy has heretofore been considered much larger than other such systems which we see as spiral nebulae, but an astronomical "electric eye" perfected by Dr. Albert E. Whitford, of the University of Wisconsin, and used by Drs. Stebbins and Whitford last summer on the Mount Wilson 100-inch telescope has furnished evidence that man does not live in an unusually large collection of stars after all.

The existence of an extensive layer of dark, obscuring material near the central plane of the Milky Way was confirmed last year by Dr. Stebbins. This non-luminous gas or dust fills up large spaces between the stars. It not only obscures but it reddens the light of distant heavenly objects seen through it, just as the sun looks red at sunset because it is seen through a greater amount of air. This means that the stars are actually brighter than they appear and they are therefore closer to us than has previously been estimated, making the galaxy smaller.

The photoelectric amplifier attached to a giant telescope will detect faint stars and nebulae which can not be photographed because they are lost in the "sky shine" or the diffuse light of the earth's own atmosphere.

The known diameter of the famous Andromeda nebula has been more than doubled, Dr. Stebbins reported, and its extension has been traced out to where the luminosity is only one per cent. of the general surface brightness of the sky.

In the experiments with the improved "electric eye" attached to the telescope of the Carnegie Institution on Mount Wilson, California, Dr. Stebbins, who is also a research associate of the Carnegie Institution, extended the usefulness of the new instrument in measuring light and color of faint stars, clusters of stars and nebulae.

Dark stuff in outer space, unseen by human eyes, is considered probably actually to outweigh the luminous material revealed in the form of shining stars. Any reasonable assumption as to the nature of the interstellar dust leads, it is said, to enormous calculated masses.

THE TREATMENT OF RADIUM POISONING

FUTURE sufferers of radium poisoning may have hope for recovery by a method now being developed by Robley D. Evans, physicist of the University of California, and Dr. R. Ware, of the Los Angeles General Hospital.

These investigators are now trying it out on the few survivors of the unfortunate luminous dial paint workers of ten or more years ago, and so far the results are promising. Since radium workers in mines and in laboratories will always be exposed to the dangers of this dread form of poisoning, development of a successful method of treatment is much needed.

The method follows the work of Dr. J. C. Aub, Professor F. B. Flinn and Dr. S. M. Seidlin and depends on the fact that calcium and radium are very similar in chemical properties. The calcium absorbed by the body goes mainly into the bony structure and therefore the radium also accumulates there. Since the bones are comparatively permanent in composition the radium remains in place, giving off radiations which wreak destruction on the blood-producing centers as well as on the surrounding bone structure.

Now an excess of parathyroid gland hormone will disturb the normal calcium metabolism, causing the system to loose an excess of calcium. Consequently it ought to eject radium too. Of course after this depletion of the calcium has gone far enough the diet must be made rich in calcium to give the bones a chance to regain their proper strength. Essentially the process is a rinsing out of the radium-contaminated calcium and a substitution of fresh pure calcium. It is a drastic treatment.

To date it has speeded up the rate of elimination of radium to three times the normal rate. This is not yet enough to save the life of a victim, but information gained in these experiments has made possible a modified treatment which it is hoped may at least lengthen the remaining life span for those victims who have had radium poisoning for a decade or more.

ITEMS

A PRELIMINARY examination of the data from the stratosphere flight of Lieutenant-Commander T. G. W. Settle and Major Chester L. Fordney indicates that it was a complete success from the scientific standpoint. In a statement to Science Service, Professor Arthur H. Compton, of the University of Chicago, gives high credit to their efforts and skill, and also to the painstaking preparation of the cosmic ray apparatus by Dr. R. J. Stephenson. Definite results are not yet ready for announcement as a considerable amount of time will have to be devoted to the study and analysis of the data before their full significance can be put into form for publication.

HAVING discovered that ostrich meat has a delicious flavor, the Moscow Zoological Park has begun breeding ostriches on a large scale by means of incubators and also by a method that is described as forced mating, yielding from every pair between 15 and 16 chicks a year. When fully grown the birds weigh between 100 and 135 pounds. It is planned to breed large numbers of ostriches in the southern steppes of the U. S. S. R. Thanks to its thick layer of fat, which originally served as a protection from the semi-tropical sun, the ostrich can support the cold Russian winter, even at the latitude of Moscow. In its new home the ostrich holds to its native calendar and begins to lay eggs in the fall, which corresponds to the spring of the southern hemisphere.

THERE are nearly 500,000,000 apple trees in the world, and of these the United States has approximately one quarter. A British Empire Marketing Board report, just issued, points out that, though the numbers of apple trees in Britain, the United States and many parts of Europe have fallen considerably, there has been no decline in the average amount of fruit produced. In the United States, the reduction was by 100,000,000 between 1910 and 1930. The maintenance of production is due to the gradual rationalization of the world's apple industry, many countries having followed the example of America in growing apples on a large scale in commercial orchards. The estimated number of apple trees in Great Britain and North Ireland is only 15,370,000, and Britain normally takes more than half the United States apple exports.

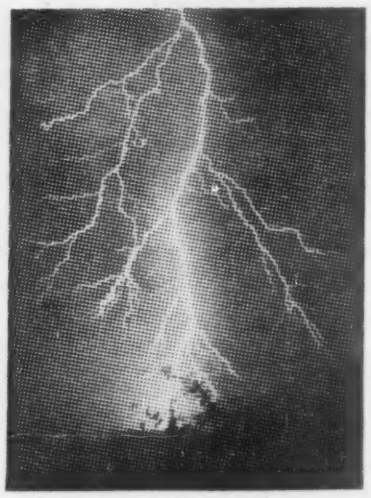
GOLD enough in the oceans of the world to give every living person $14,000 worth, but so dilutely dissolved that no known technique can extract it profitably. This is the tantalizing picture that has been built upon the tables of mineral content of sea water drawn up by G. W. Littlehales for the National Research Council, and published in the 1933 Physical Tables of the Smithsonian Institution. There is also silver in solution in the ocean water—a thousand times as much as there is of gold. And besides this, ocean water contains quantities of iron, manganese, phosphorus, barium, iodine, copper, arsenic and zinc. In considerably higher concentration are chlorine, magnesium, calcium, sodium and potassium.

DETERMINING the freshness of fish by electricity is the latest achievement of the U. S. Bureau of Fisheries. Maurice E. Stansby and James M. Lemon, at the Bureau's Gloucester laboratories, needed a quick, accurate method for telling just how long a fish had been out of water, in connection with some work on the keeping qualities of haddock. They found that the fish, soon after being caught, became stiff, then as time went on, relaxed and became more and more limp until finally it began to decay. They knew that the stiffness was caused by the production of lactic acid, the "sour" of sour milk, which caused the muscles to become rigid. Then, as this disappeared and the muscles were attacked by their own juices, they became limp. How to follow this process more exactly than was possible by simply seeing how limp a fish became was the problem. Stansby and Lemon solved it when they found, as was predicted by theoretical chemistry, that they could pass more electricity through a fresh fish than through one that had been caught some time.

MEN and boys over fourteen years must spend at least $1.41 per week on food, in order to get enough to maintain their health and ability to work, a committee appointed by the British Medical Association has just reported. Women and girls over fourteen must spend $1.18 for their week's food. For children over twelve the committee found $1.28 the minimum for a week's food for each child. Below twelve the minimum weekly food cost was found to be as follows: from ten to twelve years, $1.14; from eight to ten, $1; from six to eight, 86 cents; from three to six, 82 cents; over two, 74 cents and for year-old infants, 64 cents. The prices were based on a daily food allowance of 3,400 calories for a grown man, with correspondingly less for women and small children. The investigation was carried out with the aid of the Milbank Memorial Fund.

LITTLE animals somewhat like monkeys, but very much more primitive, lived in what are now the Badlands of South Dakota 35,000,000 years ago or some such matter. Broken fragments of the skull and jaws of such a creature, found last summer by geologists of the Scott Fund Expedition of Princeton University, have just had their identity established by Professor Glenn L. Jepsen. The animals belonged to the primate sub-family Plasiadapidae, and lived during Oligocene time, which is well back toward the beginning of the Age of Mammals. The fossils are the first of their kind and age to be found in North America, and the skull is stated to be the most perfect representative of its zoological group yet discovered anywhere.

THE high death rate from tuberculosis among girls in the 10–19-year age groups is not due to the way they dress or the dieting fad, but to the fact that girls in the adolescent period are physiologically more susceptible to tuberculosis than boys in the same age group, according to a statement made by Dr. Lloyd Arnold, of the University of Illinois College of Medicine, at a meeting of the Illinois State Nursing Association. Dr. Arnold exhibited charts showing that since 1870, when the first vital statistics in this country were collected, the peak age for deaths from tuberculosis among girls was in the 10–14-year group, and it has remained in the same group in every succeeding decade. In 1870, there were 208 girls who died to each 100 boys in the group of children 10–14 years. Comparable figures were: 1880, 230; 1890, 250; 1900, 257; 1910, 262, and in 1920, 255.



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INTERCORTICAL SYSTEMS of the HUMAN CEREBRUM

Mapped by Means of New Anatomic Methods

BY JOSHUA ROSETT

Scientific Director, Brain Research Foundation
Assistant Professor of Neurology, Columbia University

AFTER years of labor in perfecting anatomic methods applicable to the study of the association systems of the human cerebrum, Dr. Rosett has succeeded in producing detailed maps showing their course and extent. This publication is of signal importance. The material is decidedly new. A major project in brain research—a trenchant study in a field that until now has defied investigation—is brought to its culmination within the pages of this volume.

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SCIENCE NEWS

Science Service, Washington, D. C.

UNEMPLOYED MEN TO WORK ON PREHISTORIC REMAINS

A THOUSAND unemployed men will soon be disinterring secrets of aboriginal history in five different states. A new federal civil works project approved by Harry L. Hopkins, Federal Civil Works Administrator, thus provides unexpected opportunities for scientific excavation on a large scale.

All but one of the sites to be excavated are in the South—in Florida, Georgia, North Carolina and Tennessee. One is in California. These locations, selected by the Smithsonian Institution as important to an understanding of America's ancient history, have heretofore been considered projects too large to be undertaken by the institution. Those who will direct the work have been tentatively chosen.

Reconstruction of the lost story of what happened in Southeastern United States in the days before Columbus will be speeded by this new research in that section. Matthew W. Stirling, chief of the Bureau of American Ethnology, points out that not long ago the ancient story of the American Southwest was as confusing as that of the Southeast seems to-day. But now, through systematized research, the story of the Southwest is told in remarkable detail from a time before the Christian era down to the Spanish conquest.

One site in Florida, where 229 men will be put to work, consists of a system of prehistoric earthworks built by unknown Indians who lived in the Everglades before the Seminoles came there. These elaborate earthworks were discovered by Mr. Stirling only two years ago. So great was the pattern of earthen ridges that Mr. Stirling considered it amazing that no one had previously reported their existence. They are located near Okeechobee, about fifteen miles south of Indiantown, Palm Beach County. Mr. Stirling will supervise exploration at this important site and may also direct two other excavations in Florida, one near Artesia, in Brevard County, and the other near Bradentown, Manitee County. These two projects will employ 228 men.

In Georgia, Dr. Arthur Kelly, formerly of the University of Illinois, will direct the exploring of a large mound within the city limits of Macon. This site, believed to be an old Hitchiti village, will call for 205 excavators. In North Carolina, 104 men will explore a large mound near Murphy, Cherokee County. This is believed to be the old Cherokee village of Gausili visited by the Spanish explorer DeSoto.

In Tennessee, Dr. Frank H. H. Roberts, Jr., of the Smithsonian, will take charge of the excavation and restoration of Indian mounds in Shiloh National Military Park at Pittsburgh Landing. The identity of the Indians who built these mounds and the age to which they belong have never been discovered. The work will not disturb soldier burials. One hundred thirty men are to be employed.

California will have 208 men at work opening up the Yokut Indian mound near Taft in Kern County. Dr. William D. Strong, of the Smithsonian, is expected to direct the project. This is one of the key sites in California's prehistory, with a story extending indefinitely into the past.

LIFE ON THE PLANETS

LIFE is more likely to exist on Venus than on Mars, if it is to be found on any planet besides the earth. Life in anything like the form we know it would be quite impossible on any but the three planets mentioned. These inferences may be drawn from facts presented by Dr. Walter S. Adams, of the Mount Wilson Observatory, in a lecture before the Carnegie Institution of Washington.

Life as a physical thing is first of all conditioned by the atmosphere, and to support life a planet must have a friendly atmosphere. Mercury, the little planet nearest the sun, apparently has no atmosphere at all: it was too little to hold one by the attraction of gravity. Besides, on its sunward side Mercury is terrifically hot—hot enough to melt lead.

At the other extreme are the huge outer planets, Jupiter, Saturn, Neptune and Pluto. The larger of these have very thick atmospheres, perhaps thousands of miles deep, held by the attraction of their great mass. But they are so far from the sun that they are perpetually cold, far too cold for the support of life.

Mars has an atmosphere, but because the mass of the planet is only about one tenth that of the earth, this atmosphere is thin and meager. Few clouds are ever seen in it, though the existence of what seem to be polar snow caps would hint at the presence of some water. No free oxygen, indispensable to life, has been detected on Mars by spectrographic studies. Finally, the thinness of the atmosphere can do little to mitigate the contrast between the heat of Martian noon and the freezing cold of Martian midnight. So if life exists there it must be of the most primitive and toughest type—possibly like the lichens of the earth.

Venus, blanketed in perpetual veils of clouds, may have oxygen below their level, though again the spectrographs have never proved its existence there. But with abundant water, and a rich atmosphere to modify the ardor of the sun, life may be possible.

The atmospheres of the planets are studied by analyzing the sunlight reflected from them with a spectrograph, and identifying the dark "absorption bands" characteristic of each element and chemical compound. Thus, such strange gases as methane and ammonia have been found in the atmospheres of the larger planets. Planetary temperatures are measured by focusing light from different parts of their surfaces, or from their entire areas, on extremely delicate electrical devices known as thermocouples.

BONES OF A BIRD-LIKE DINOSAUR

PALEONTOLOGISTS at the University of California have discovered the fossil remains of a bird-like dinosaur which inhabited the sand dunes of northern Arizona about 80,000,000 years ago. This animal belonged to

the Jurassic geologic period. It walked on its hind legs, and looked somewhat like a featherless ostrich.

The discovery of its remains was made by members of the party of Ansel F. Hall, chief forester of the U. S. National Park Service, who led an expedition into the Monument Valley of Arizona some months ago.

The find is considered to be of great value because it is unusual to discover fossil remains of these animals, owing to the fact that the delicate nature of their bones do not lend themselves to fossilization. Thus representatives of this species are very rare, and are highly prized by museums.

The fossil remains of this dinosaur are now the property of the museum of paleontology of the University of California. Dr. C. L. Camp, director of the museum, says that Robert H. Thomas, a student at the university, and a Navajo Indian, Max Littlesalt, are the discoverers of the animal.

"One evening," he explains, "the men visited the ruin of Keet Seel, one of the famous cliff dwellings of northern Arizona. They climbed an old Indian trail up a cliff which was about 600 feet high. Part of the trail consisted simply of hand holes in the rock. When the men were about 100 feet from the top, they came upon the dinosaur remains. These lay under a ledge protected from the rain. The skull had weathered away as well as part of the backbone and part of the limbs, but the rest of the skeleton was well preserved. From the position of the bones it is likely that death came upon the animal when it was crouched down like a setting hen. Its legs were doubled under it."

Dr. Camp says that dinosaurs of this early period are distantly related to the reptilian ancestors of birds. They walked in the manner of birds, and had beaks like birds. It is thought that they lived by sucking eggs laid by larger dinosaurs.

The discovery of this member of the dinosaur group is the first that has been made in Arizona. However, fossil remains of dinosaurs of the Cretaceous geologic period of 70,000,000 years ago have been found in this area on a number of occasions.

ENCEPHALITIS AND INFLUENZA

ENCEPHALITIS, sometimes known as "sleeping sickness," and recently epidemic in St. Louis, may actually be virus influenza of the brain and nervous system.

This new theory of the disease is suggested by Drs. Earl B. McKinley and Elizabeth Verder, of the George Washington University School of Medicine, in a report to the Society for Experimental Biology and Medicine. The report is announced in the Proceedings of the Society.

The suggestion that encephalitis is brain "flu" of virus origin is purely theoretical, Dr. McKinley emphasized. So far, there is no proof for it, although there seems to be considerable circumstantial evidence. The theory developed as the result of ten years' investigation and study of the disease.

Dr. McKinley pointed out that the name encephalitis simply means inflammation of the brain. So far, no one has discovered what causes the inflammation. His own research has shown definitely that it is not caused by bacteria or disease "germs." Both Dr. McKinley and other investigators believe that it is caused by a filterable virus, such as causes smallpox and measles. A filterable virus has recently been found to be the causative agent of the common cold and of influenza.

Dr. McKinley suggests that the same virus is the cause of both "flu" and encephalitis. The difference in the diseases is due to the fact that the virus attacks different parts of the body. In virus influenza, the nose, throat and lungs are attacked. A variety of influenza, known as gastrointestinal "flu," has been observed recently, in which the virus apparently attacks the stomach and other digestive organs, causing stomach and digestive upset with or without the other symptoms of influenza. When this same virus attacks the brain and nervous system, encephalitis or brain "flu" results, in Dr. McKinley's opinion.

Encephalitis first appeared after the influenza outbreak during the World War. It frequently follows an attack of influenza. In the St. Louis epidemic the patients suffered digestive upsets at the beginning of the encephalitis attack. These facts all support the new theory.

Physicians have long suspected a relation between influenza and encephalitis, but it was impossible to explain this relation so long as a bacillus instead of a virus was considered to be the cause of "flu." Now that both diseases are known to be caused by a virus, a relation between them may again be considered, and perhaps explained along the lines Dr. McKinley suggests.

ITEMS

YAKUTSK, in Siberia, was the nearest city to the epicenter of Monday's (December 4) earthquake, according to an announcement of the U. S. Coast and Geodetic Survey, made after studying data gathered telegraphically by Science Service from four observatories. The approximate location of the epicenter was given as in latitude 63 degrees north, longitude 135 degrees east. This point is somewhat to the northeast of the city of Yakutsk, and east of the Lena River. The earthquake was deep-seated, the slip occurring some miles beneath the surface; but the shock was not severe enough to cause material damage, the scientists estimated.

MAUNA LOA, Hawaii's loftiest active volcano, broke into eruption at its summit crater at 5:43 A. M., Hawaiian time (11:13 A. M., Eastern Standard Time) on Saturday, December 2. Apparently there are three lava fountains, under three towering fume columns. The fumes rise 4,000 feet above the mountain, which itself has an altitude of 14,000 feet. The northern fume column hangs over the center of the crater. Dr. T. A. Jaggar cables that he has started for the summit, with a party of scientists from Hawaii National Park. The Interisland Airways Company dispatched a plane for aerial observation of the eruption. There was an earthquake disturbance for an hour following the beginning of the outbreak, but afterwards the ground quieted. A watch is being kept on the flanks of the mountain for possible lava flows, but as yet we have no means of telling whether these will occur.

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SCIENCE NEWS

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A NEW SOURCE OF PROTONS

A PLENTIFUL supply of atomic bullets for shooting at other atoms in the hope of transmutation and atomic energy release is assured by a Massachusetts Institute of Technology discovery.

A source of protons that is nine times as prolific as any previously known was devised by Drs. Edward S. Lamar and Overton Luhr, working in the new Eastman Research Laboratories. Protons are the positively charged kernels of hydrogen atoms and the most effective projective known to science for atom smashing.

Their new source is an electric arc operating in hydrogen at low pressure between an incandescent filament and a neighboring metal electrode. Ordinarily such an arc would produce ions of which about ten per cent. would be protons and the remainder molecular ions. However, by surrounding the arc with a third electrode maintained at a negative potential of a few hundred volts, the percentage of protons produced is immediately increased to approximately 90 per cent. Dr. Lamar and Dr. Luhr are hopeful of still further raising the percentage.

The new proton source will be applied to the 10,000,000 volt Van de Graaff direct current generator recently tested at the research station at Round Hill, Massachusetts. Dr. Karl T. Compton, who collaborated in the investigations out of which the Lamar-Luhr discovery arose, explained that protons speeded at 7,000,000 volts in the Van de Graaff generator are as effective as ordinary charged hydrogen molecules sped by twice that voltage, 14,000,000 volts. For this reason, the plentiful protons of the new source will be used as missiles when the giant generator is turned to the task of attempting the release of the enormous stores of energy locked within the atoms.

THE WEIGHT OF THE NEUTRON

PHYSICISTS are attempting to determine the weight of the neutron, the fundamental particle of matter that a relatively few months ago was totally unknown. The present status of the neutron mass controversy was summarized recently by Dr. R. M. Langer, of the California Institute of Technology.

All agree that it is almost equal to the hydrogen atom, which is 1.0078 on the chemical scale, but it is most important to know whether the neutron is heavier or lighter and by how much. Small differences in mass make big differences in most other things.

The French workers, Dr. F. Joliot and Mme. Joliot, the daughter of Mme. Curie, assert that the neutron is heavier than hydrogen and equal to 1.012. This explains how protons break up into neutrons and positive electrons, and why the beryllium nucleus is stable. But Dr. Langer pointed out that these assertions are not yet to be accepted as facts and depend on questionable interpretations of experiments.

The English physicist, Dr. J. Chadwick, who discovered the neutron with the aid of preliminary work by the Joliots, chooses the mass 1.0067, which is slightly lighter than hydrogen. His interpretations are well established, but the experiments are not very accurate. Dr. Langer believes this value is close but not necessarily exactly right.

A third group, represented by Professor E. O. Lawrence at the University of California, insists that the neutron is considerably lighter, namely 1.0006. This is claimed because some of the experiments seem to show that the deuton is unstable and breaks up when it strikes other nuclei. Dr. Langer holds that it must yet be proved that there are no more probable interpretations of their work.

Dr. Langer contends that by far the most precise means of determining the neutron's mass is to use experiments on the disintegration of lithium with deutons. This process has been carefully studied by Lord Rutherford, Dr. M. L. E. Oliphant and Dr. B. B. Kinsey in England. They measured the energy of the helium found in the disintegration. From their data, Dr. Langer calculated that the mass of the neutron is 1.0062, which is only 0.0005 less than Dr. Chadwick's guess. This small difference is, however, equivalent to half a million volts.

The mass 1.0062 would mean that the deuton is stable, but would be easily decomposed, while the proton might very readily break up into a neutron and a positive electron. Until this question of the neutron's mass is decided, according to Dr. Langer, little progress can be made with the theory of the nucleus.

"DEUTERIUM" OR "DIPLOGEN"

AMERICAN and British scientists do not agree on a name for the double-weight hydrogen atom, discovered in America and now the subject of intensive research in chemical and physical laboratories throughout the world.

Lord Rutherford of Nelson, the eminent British physicist, head of the famous Cavendish Laboratory at Cambridge University, in a Royal Society discussion upon heavy hydrogen, urged the adoption of "diplogen" as the name of the double weight hydrogen atom and "diplon" as the name of the nucleus or kernel of heavy hydrogen.

Professor H. C. Urey, of Columbia University, New York, one of the group of Americans who discovered heavy hydrogen, had already christened the atom "deuterium," and at the University of California the nucleus had been labeled "deuton." Both these terms have been widely used in scientific publications in America.

The principal objection to the American terms lies in the phonetic similarity between deuton and neutron. Neutron is the uncharged or neutral particle of nearly the same weight as a proton or ordinary hydrogen nucleus that was discovered about two years ago in Cavendish Laboratory. If those discussing these atomic particles have colds or do not speak distinctly, deuton and neutron are easily confused in speech, according to Lord

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CONTENTS

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Rutherford. In this contention he was supported by Dr. N. V. Sidgwick, Oxford reader in chemistry, who reported that at the recent Chicago meeting of the American Chemical Society he noticed much oral and auditory confusion between deuton and neutron.

Although the right of American discoverers to decide on the name is recognized, it was stated that the names diplogen and diplon were conceived as the result of consultations between British investigators when the existence of heavy weight hydrogen was suspected on theoretical grounds. This was before the American discovery.

Dr. Frederick Soddy, of the University of Oxford, who has investigated varieties of elements and who coined the word "isotope," protested against the idea that ordinary mass one hydrogen and the heavy weight hydrogen of mass two are really isotopes. He considers hydrogen and deuterium (diplogen) homologues like oxygen and ozone rather than true isotopes.

The British hailed the American discovery of heavy hydrogen as of great importance even though they did not agree with the proposed American nomenclature.

COSMIC RAY INTENSITY AND AN EXPANDING UNIVERSE

A SERIOUS difficulty in the Lemaître hypothesis that the universe started as a monster radioactive atom that became the expanding universe is brought out by the researches of Professor P. S. Epstein, of the California Institute of Technology.

Professor Epstein's extension of the expanding universe theory has demonstrated that all events that occurred while the universe was young were low in energy compared with the same events taking place at a more mature time.

Abbé Georges Lemaître, now lecturing at Catholic University of America, suggested that the cosmic rays now bombarding the earth have survived from the primordial "explosion" of the universe. Professor Epstein finds from his extension of the expanding universe theory that cosmic rays are feebler the older they are, and that those emitted when the universe started as a small body have no energy. Just as ordinary light is reddened as it comes from the distant reaches of space, so cosmic rays are diminished in energy on their way to earth.

The expanding universe theory was originated by the Russian astronomer, A. Friedmann, and independently by Abbé Lemaître, and it was brought to the attention of the scientific world by Dr. Willem de Sitter, the Dutch astrophysicist, and Sir Arthur Eddington. Dr. Fritz Zwicky, of the California Institute of Technology, first pointed out that unless cosmic rays originate in our own part of the universe they would cease to be vigorous enough to penetrate through our atmosphere.

The considerations about the age of cosmic rays are considered one further argument against the short time scale, of the order of 2,000,000,000 years, advocated by most of those who favor the theory of the expanding universe.

PLANETARIUM TO REPRODUCE ANCIENT SKIES

THE night skies seen from Palestine in the year 5 B. C., at the time of the birth of Christ, are being shown in the Fels Planetarium of the Franklin Institute for two weeks, beginning on Sunday, December 17.

Visitors will first see the familiar December evening sky of Philadelphia. Then they will be shown the sky of present-day Palestine, which is about 32 degrees north latitude, or eight degrees south of Philadelphia. The effect of "precession," by which the north pole of the heavens describes a large circle in the sky during the course of 25,800 years, will then be shown.

The sky will be "set back" nearly two thousand years, and a night in December, 10 B.C., will be displayed. Because of the precessional change, the Southern Cross could then be seen from Palestine, and from points as far north as 37 degrees latitude. Now it is not seen north of 27 degrees, which is the latitude of southern Florida.

As the planets are then caused to move in the orbits similar to those they actually took at that distant time, the planetarium visitors will see Jupiter and Saturn draw into conjunction, as they did three times during the year 7 B. C. Some Biblical authorities have ascribed the origin of the "Star of Bethlehem" story to this phenomenon.

The exact date of the birth of Christ is not definitely known, but it is supposed that it was between 7 and 5 B. C., and the planetarium demonstration will conclude with the stars and planets the way they appeared on the night of December 24 of the latter year.

Though the planetarium instrument can reproduce the precessional cycle, taking nearly 26,000 years, in a minute, the ordinary yearly motions of the sun, moon and planets are not speeded up accordingly. To set them back 1940 years, at the rate of a year in seven seconds, the fastest of which the instrument is capable, will require nearly four hours.

THE PRODUCTION OF VITAMIN B_1

A METHOD for obtaining pure vitamin B_1 in large quantities has been developed by Drs. R. R. Williams and Walter H. Eddy, Teachers College, Columbia University. Chemical details of the method are given in a report to the Carnegie Institution of Washington.

By this new method, which is still in process of improvement, yields of from 250 to 300 milligrams of vitamin in crystalline form have been obtained from 50 kilograms of rice polish. While this amount seems very small when considered in terms of large scale production of ordinary substance, since 100 milligrams is only one and a half grains, roughly, and 50 kilograms is over 100 pounds, it represents from five to fifteen times the yield obtained heretofore by other investigators.

Lack of this vitamin causes nervous disorders, among them beri-beri. While the amounts necessary for health can be added to the diet by ordinary foods such as whole grain cereals, chemists need to have rather large supplies of it in crystalline form for further investigations as to

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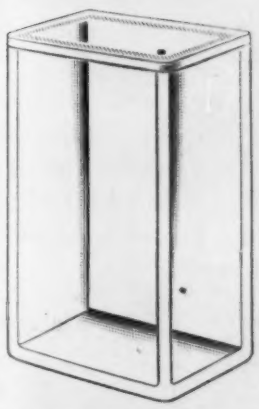

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EVERY patient entering an American hospital in the future will have, in addition to routine tests of his pulse, blood pressure and certain other body fluids, a test of his basal metabolism, if the suggestion of Dr. Francis G. Benedict, director of the Carnegie Institution's nutrition laboratory, is followed.

This test is widely used at present to determine the functioning of the thyroid gland which plays an important rôle in governing the rate of metabolism. All interchanges of energy in the body are grouped under the general name of metabolism, and the energy of mere existence is called basal metabolism, one authority has said in explaining this complex subject.

Dr. Benedict points out that the study of basal metabolism has been one of the major activities of the nutrition laboratory. He finds that almost all well-established American hospitals to-day have their metabolism section, but for the most part the tests are made chiefly on sick persons as an aid to diagnosis. In Europe, however, he found that this test is very little used.

In suggesting that the next logical step for American hospitals is to make the test a routine procedure on all patients, he reported that in the nutrition laboratory there has been devised an apparatus which makes possible the measurement of basal metabolism without requiring unusual skill on the part of the laboratory technician.

Departing somewhat from the study of human metabolism, investigations are now being made in the laboratory of the metabolism of the white rat, the rabbit, the hibernating marmot or woodchuck, the pigeon and the dove, large domestic animals, the chimpanzee and a species of monkey.

Dr. Benedict points out that the perturbed metabolism of sick humans is often paralleled by the normal metabolism of some animal, and hence one can not stress too greatly the importance of a better understanding of the metabolism of various animals.

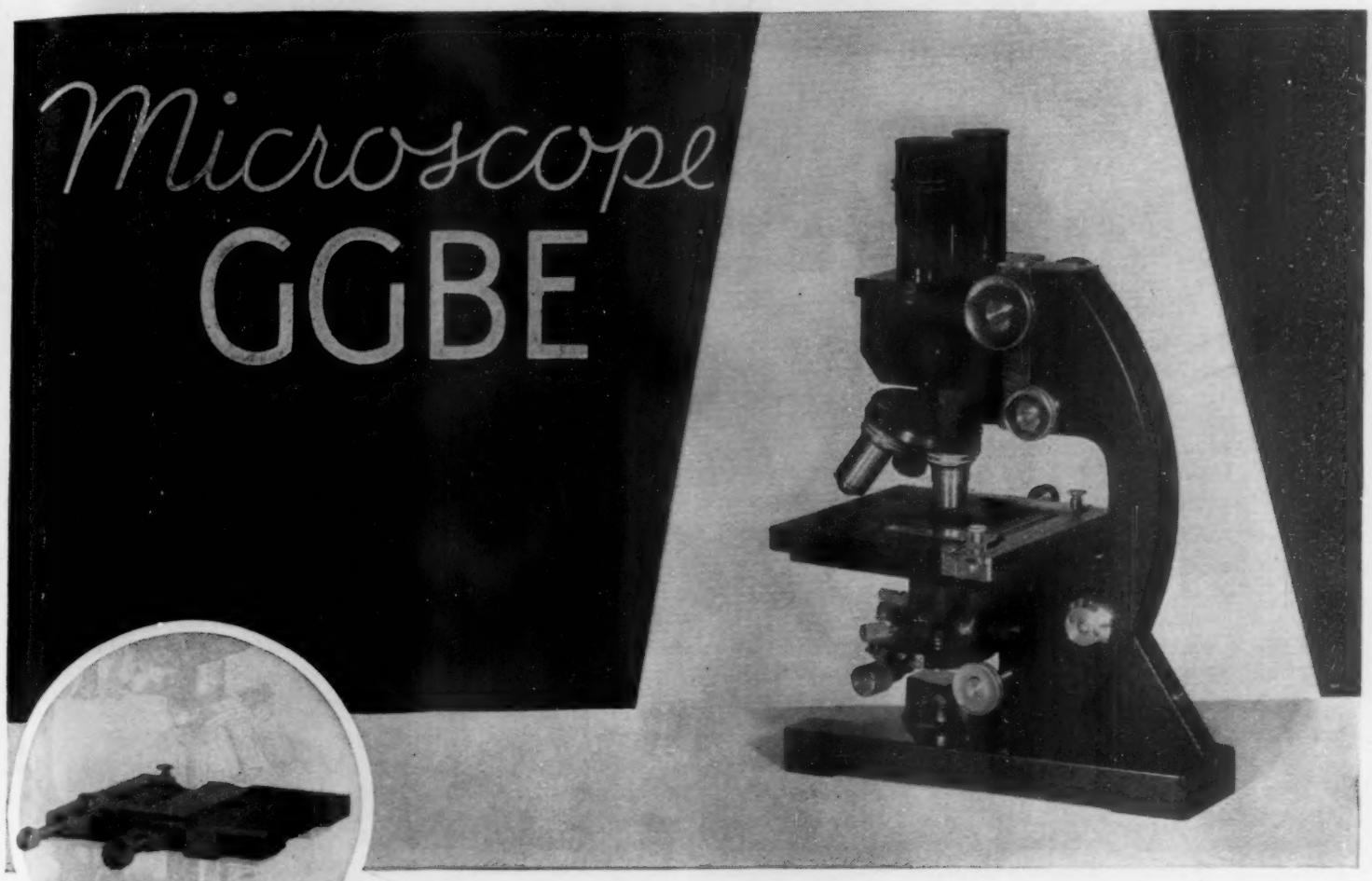
ITEMS

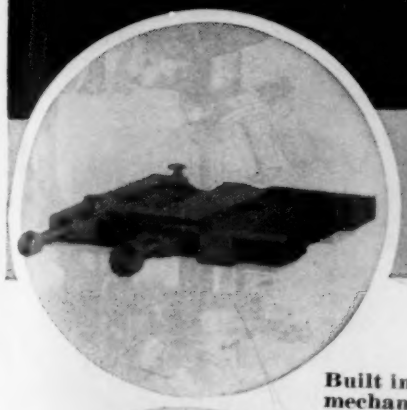
WINTER began officially at 1:58 A. M., Eastern Standard Time, on December 22. At that moment, according to data furnished by the Nautical Almanac Office of the U. S. Naval Observatory in Washington, the sun reached the farthest south position of the year, which is called the winter solstice. As seen from Washington, the sun at noon on this day was about 28 degrees above the southern horizon. Because the sun is so low in the sky, its rays of light and heat strike the earth at a grazing angle, and are less concentrated than in the summer time, when it is about 75 degrees high at noon. This makes for the cold weather which northern countries are now beginning to experience. When the sun is low in the northern hemisphere, it is high in the southern, so the winter solstice marks for the people of Australia and South Africa the beginning of summer. Their cold season comes during our summer months.

EXPERIENCE with a new anesthetic which is injected directly into the blood and which may prove as valuable as ether for certain types of surgical operations was reported by Dr. Gavin Miller, of Montreal, to the Canadian Medical Association. The new anesthetic is called evipan and was produced by a German pharmaceutical manufacturer. It has been tried extensively in Germany and England. Only one death was attributed to the anesthetic in over 20,000 cases in which it was used. Chemically, evipan is known as the sodium salt of N-methyl-C.-C.-cyclohexenyl-methyl-barbituric acid. The anesthetic, injected directly into the blood-stream through a vein in the arm, produces a deep, normal sleep within thirty seconds. The operation can be started immediately. After the operation the patient awakens easily and gradually without any unpleasant after-effects. In Dr. Miller's experience, evipan is more effective if morphine or a similar drug is given first.

HEAT rays of extra-long wave-lengths, and their reactions upon striking the ozone layer in the upper levels of the atmosphere may have a peculiar significance in the earth's loss of heat to outer space, Dr. Charles G. Abbot, secretary of the Smithsonian Institution, informed his Board of Regents at their annual meeting on December 14. Among the forward steps in research conducted at the institution was the development of an especially sensitive radiation-measuring device for detecting and recording these long wave-lengths. The acquisition during the year of over a third of a million new specimens for the U. S. National Museum was another item reported by Dr. Abbot; the exact count was 348,012. They included such diverse things as the skull of a bowhead whale, several important art collections, botanical specimens from all over the world, objects of South American, Philippine and African workmanship, and a number of meteorites. At the National Zoological Park, over 1,300 animals were added, offset by 1,000 lost through death and exchange, leaving the zoo's population at the end of the year at 2,496 animals.

IN a few weeks, there will be at Columbia University a supply of about 400 grams (approximately a pound) of heavy water, similar to familiar ordinary water but with practically every hydrogen atom in it double the weight of ordinary hydrogen. Professor Harold C. Urey, of Columbia University, and one of the group that two years ago discovered the existence of deuterium or heavy hydrogen, described to the American Chemical Society's New York section the production of heavy water on a scale and at a low cost hitherto unattained. Water particularly rich in heavy hydrogen is obtained from a commercial water electrolysis plant and concentration is effected in a laboratory plant that produced eight to ten grams (approximately one third ounce) per day. The production cost is about $15 a gram, which is about a tenth of the costs reported from other laboratories engaged in similar heavy water production.





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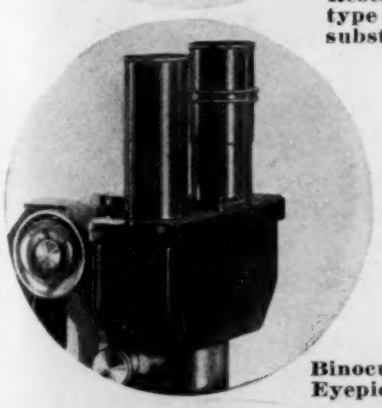

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The Science Press Printing Company

An article entitled "The Journal *Science* and the American Association for the Advancement of Science," printed in the issue of the journal for October 8, 1926, contains the following paragraphs:

> In this connection acknowledgment should be made to the printers, The New Era Printing Company of Lancaster, Pa., and especially to Mr. Andrew Hershey. In 1893 they were printers of a local newspaper and of local job work. They offered terms much lower than any city printers and maintained the same rates for SCIENCE for twenty-five years. They proved themselves to be excellent printers and in 1920 were printing some fifty scientific journals. After one partner had died and the other two had advanced in years, the business was sold to a promoter, not himself interested in printing. Charges were greatly increased and the printing became less efficient.
>
> Efforts were made to purchase the printing plant with cooperative ownership by the scientific journals that it printed, but these failed, partly because the $300,000 asked included at least $100,000 for the good will in large measure given to the business by SCIENCE, and partly owing to the difficulties of ownership by the societies and institutions that controlled the journals. When the Carnegie Institution was established in 1902, the editor of SCIENCE proposed the organization by it of an office for scientific printing and engraving which could have been made self-supporting, and, as in the case of the Oxford and Cambridge presses, would have rendered valuable service by assured continuity and expertness in scientific printing; but the plan was not adopted.
>
> *Science* and the other journals of The Science Press were for a time printed in Utica, N. Y. In 1923 The Science Press Printing Company was incorporated with its office at Lancaster and with the cooperation of Mr. A. E. Urban as general manager and of those compositors, pressmen and proofreaders who had given that city distinction as a center for scientific printing. This company is now responsible for printing *Science* and a considerable number of other scientific journals, monographs and books.

As stated in this quotation The Science Press Printing Company was established to print *Science* and the other publications of The Science Press, including *The Scientific Monthly, The American Naturalist, School and Society,* and the Biographical Directories of "American Men of Science" and "Leaders in Education." The composition and press work of these publications show the high standards that are maintained. In order to bring them out efficiently and promptly —for example, the entire contents of an issue of *Science* can be put in type in one day and each week during 1932 more than 14,000 copies of *Science* were printed, bound and mailed in a little more than one day—it has been necessary to have a shop of considerable capacity and to take in other work. The press now prints some thirty scientific and educational journals and series, and has printed many books and monographs.

It may be regarded as a real contribution to science that there should be a plant in which the workers are trained to deal with scientific material. Innumerable commendations of the accuracy of the proofs have been received; to quote only one, the late Professor E. S. Morse wrote to the editor of *Science:* "I corrected my first proof a year before you were born and the one I returned yesterday was the first one in my long experience that needed no correction."

It is also an advantage for scientific men to have relations with a company that maintains the same rates for the same kind of work under the same conditions. High pressure selling and competitive bidding—among the causes of the present economic depression which the codes promoted by President Roosevelt are intended to abolish—are thus unnecessary. A scientific man may assume that work entrusted to the press will be done at a cost as low as is consistent with high standards of work and the best conditions of employment for the workers. This is less than the cost of equally good work in large cities where wages and rents are much higher, but it is not so low as for inferior printing or where the welfare of workers is disregarded.

While the press must use efforts to obtain work when the capacity of the shop requires it, its object has been to make it as great an advantage for the scientific man to have work done by it as it is for it to do the work. This policy has succeeded, for employees have not on the average been idle as much as one day a year since the press was established; no employee has been laid off (up to October, 1933) even during the economic depression; wages were decreased by 10 per

cent. for only about fifteen months, when costs of living were lowest; the press has a profit sharing system for employees; all earnings on the stock have been used to improve the plant. The Science Press Printing Company is a business corporation; but it is also a scientific institution. It is conducted on the same principles as the journals that it prints. Its object is the advancement of science—at the same time it must be self-supporting, and it is desirable to make profits that are used to increase its usefulness.

Adequate facilities for the publication and printing of research work are essential for the advancement of science. The cost of conducting a piece of research that deserves publication, counting the time of the scientific workers and all overhead, may on the average be $2,000. The charge for printing by The Science Press Printing Company of a 32 page article or monograph in an edition of 1,000 copies is about $80, say 4 per cent. of the cost of the research. This is less than the interest on the investment, if there is a delay of a year in publication. Ordinary depreciation on machinery is charged at 10 per cent. a year, but it is much larger in the case of scientific research where delay seriously lessens the usefulness of the work and prevents the early recognition of its value. It is most important for science and for scientific men that there shall be prompt and efficient printing and publication of research.

The Science Press Printing Company has had more work offered to it continuously than it could do promptly, but owing to the completion of the printing of "Leaders in Education," followed by the fifth edition of "American Men of Science" (equivalent to 5,000 pages of the usual book) recently completed, it will soon want one or two scientific journals or several books and monographs in order that the full capacity of the shop may be used and all employees be given steady work. This is not only a need of the press but also an opportunity for those who take advantage of it. It is further reasonable to assume that The Science Press Printing Company deserves the support and cooperation of scientific men to the same degree as an institution, a society or a journal that contributes to their welfare and to the advancement of science.

Dr. J. McKeen Cattell was responsible for the organization of The Science Press Printing Company ten years ago and has been president of the corporation. Since the untimely death in 1926 of A. E. Urban, the first secretary and manager, Jaques Cattell, one of the editors of the last two editions of "American Men of Science," has been secretary; George M. Houck has been associate manager in charge of the composing room; Miles W. Eckman has been associate manager in charge of the press room. Inquiries concerning printing should be addressed to the secretary at Lancaster, Pennsylvania.

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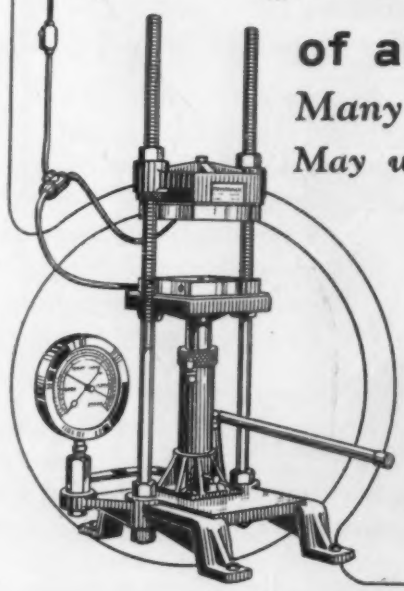

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SCIENCE NEWS

Science Service, Washington, D. C.

THE VELOCITY OF LIGHT

VARIATIONS in the speed of light are not accepted by Carnegie Institution scientists, on the basis of recently announced results. The discrepancies in the instrumental readings must find their explanations elsewhere. Dr. Walter S. Adams, director of the Mount Wilson Observatory, where the late Professor A. A. Michelson prepared the latest light-velocity experiments, indicated this in an exclusive statement to Science Service.

"The last hypothesis to be adopted is that the velocity of light varies," said Dr. Adams. "If a man knows accurately when the sun should set but observes that according to his watch it sets five minutes ahead of time, a logical person does not assume that the motion of the sun varies, but that his watch is wrong."

Dr. Adams' statement, copyright, 1933, by Science Service, follows:

The latest average value of the velocity of light, which will doubtless be accepted as the world standard, is announced by the scientists of the Mount Wilson Obvervatory of the Carnegie Institution of Washington as 299,774 kilometers (186,780 miles) per second. Further analysis of the observations may change the last figure by one or two units. This value compares with the Michelson 1926 result of 299,796 kilometers per second obtained as the result of observing the passage of light between two mountain peaks in California. The new value is 22 kilometers per second, or seven thousandths of one per cent., lower than the old value.

Certain unexplained variations which exceed considerably the experimental error of measurement have been found in the course of the observations. One of these had for a time a period of 14¾ days and another a long period of about one year, but neither period persisted throughout the entire series. The range of variation in each case was about 20 kilometers (12 miles) per second.

The cause of such apparent variations is first of all to be sought in instrumental sources, in possible changes in the apparatus, the length of the light-path, ground disturbances, errors in the timing mechanism or a possible effect of refractive index in the path of light. The precision required in this difficult experiment is extraordinarily high. It is only as a last resort that we should have recourse to the hypothesis that the velocity of light actually varies. We have long believed this to be a fundamental constant of nature and although a variation is conceivable it is not established by these results.

The present investigation was carried on by Dr. Francis G. Pease, of the Mount Wilson Observatory, and Fred Pearson, of the University of Chicago, working with the mile-long vacuum pipe line at the Irvine Ranch, Santa Ana, California. The apparatus was designed and first used by the late Professor A. A. Michelson. Although yielding a value for the velocity of light of extraordinarily high accuracy, it can hardly settle questions involving quantities of such a minute order as those here considered. For such an investigation it would be desirable to have quartz mirrors, a much more stable pipeline and elaborate timing devices.

Recent determinations of the velocity of light have shown a tendency toward slightly smaller values. It does not seem necessary, however, to ascribe this to other than coincidence, especially since many of the individual values in the different series of observations frequently overlap another widely.

ASTRONOMICAL EVENTS OF 1934

FOUR eclipses, two of the moon and two of the sun, the almost certain reappearance of one comet and the possible return of another, are among the most interesting events on the astronomical program for 1934.

But the most important of astronomical events have a habit of happening without any warning. The year might, for example, bring the appearance of an unheralded comet, rivaling in brilliance the famous ones of the past. It might bring a nova, or "new star," which, flashing out of previous obscurity, would exceed in brightness most of the other objects in the sky.

Perhaps the astronomers who are constantly studying the heavens will find a new member of the sun's family of planets, that, including the earth, revolve around the sun. The last such discovery came unexpectedly in 1930 when astronomers at the Lowell Observatory in Arizona found Pluto, now the most distant of the known planets.

Such things as eclipses and periodic comets can be predicted with more certainty, and astronomers do know that on February 14 the moon's shadow will pass across Borneo and the Pacific Ocean, producing a total eclipse of the sun in those regions. Only two small islands are at all well placed where astronomers can observe this eclipse. These are under Japanese mandate, and it is expected that a party of astronomers from Tokyo will set up their instruments to make those observations which are possible only at eclipse time.

There are three other eclipses scheduled for the year. On January 30 the moon will enter partly the earth's shadow, producing a partial lunar eclipse, but this will not be seen from any part of the United States. Another partial eclipse of the moon will come on July 26, which will be seen from the western states. Then, on August 10, an annular eclipse of the sun will happen. At this time the moon will come directly between the earth and sun, but the moon will then be a little farther away than normally, so that it will fail to cover the sun completely, leaving a ring of sunlight visible around it. This will be observed from South Africa, but such an eclipse is of little scientific interest, because even the narrow ring of the sun which remains visible prevents any of the usual eclipse observations.

One of the most dependable of periodic comets is confidently expected to return this year. This is Encke's comet, which comes back to the vicinity of the earth once in 3.3 years. It has been observed on every return since it was first discovered about a century ago. The

Tuttle-Giacobini comet may also reappear, though there is some uncertainty as to its exact orbit. If it should fail to appear during 1934, astronomers will not expect it until 1937.

Meteors are perhaps the least dependable of astronomical objects, as those who watched in vain for a great shower last November will be able to testify. However, it is still hoped that this November may bring a fairly decent shower, though there seems to be no possible hope that there will be a great display like the famous ones of the past. Apparently the great cluster of these meteors has passed the earth, but this year we may run into the tail end of it, as we seem to have done in 1901, after having missed the great shower the previous year.

Twice during the year the innermost of the planets, the seldom seen Mercury, will come into the evening sky. Around February 18, and again about June 14, it will remain in the western sky for a while after sunset. Venus will be in the morning sky during most of the year. At the very beginning of January, however, it will be at its greatest brilliance, and will be seen, as it has been for several months, in the western sky after sunset. Then it will pass between the sun and the earth, and on March 11 it will again be extremely bright, as a morning star. Mars will be visible during the latter part of the year as a morning star. Jupiter will be seen in the evening sky for many months. On April 8 it will be directly opposite to the sun, at opposition, and will rise at sunset, remaining visible all night. Saturn will similarly be at opposition on August 18, so that it will be conspicuous in the summer evening sky.

EPILEPSY AND TAPEWORM LARVAE

CONVINCING proof that many cases diagnosed as true epilepsy are actually cases of infestation with tapeworm larvae was presented to the Royal Society of Tropical Medicine in London by Colonel W. P. MacArthur, professor of tropical medicine at the Royal Army Medical College and consulting physician to the British Army.

The epileptic seizures are due to invasion of the brain by the eggs of the tapeworm, which form small, cyst-like masses called cysticerci, and particularly to the degeneration of these parasites after they have died. Colonel MacArthur has found as many as two hundred cysticerci in some brains.

Investigating the occurrence of epilepsy among soldiers, he found over sixty definite cases of infestation with cysticerci. Twenty such cases have been diagnosed in hospitals during the current year. Six of eight soldiers recently invalided from India and victims of cysticercosis had been certified as cases of "true epilepsy." These cases of cysticercosis, which is the medical name for the condition, have no symptoms to distinguish them from ordinary epilepsy.

Cases of cysticercosis had been wrongly diagnosed as acute mania, melancholia, delusional insanity, dementia, brain tumors, and the nervous disease, disseminated sclerosis.

Colonel MacArthur believes that in England many persons in civil life who have been stigmatized as hereditarily insane are suffering from cysticercosis acquired during residence abroad.

SENSORY COMPENSATION IN THE BLIND

THE belief that the blind are endowed with greater keenness in their other senses is as unfounded in fact as it is comforting to the sensibilities of a pitying public.

Professor S. P. Hayes, of Mt. Holyoke College, who acts as consulting psychologist for the American Foundation for the Blind, has collected new evidence that leaves little to support the unwarranted assertions often made in regard to the superior hearing of the blind and the greater sensitivity of their hands.

At the Pennsylvania Institution for the Instruction of the Blind an auditory survey was made by the resident psychologist with a very finely adjusted instrument. Groups of blind boys, blind girls and seeing women teachers were tested.

A comparison of results showed that the blind groups were inferior to the seeing group in the hearing of pitches at all levels from very low to very high. Indeed, while all the seeing subjects heard all the pitches given, some of the blind pupils failed to hear both the lowest and the highest pitches.

Even setting aside the records of those blind subjects who were judged to be at all defective in either hearing or mentality, the experimenters found the same superiority of the seeing.

A test for the recognition of objects by touch and hearing was given to the pupils and blind teachers of two schools for the blind, and then repeated with groups of Mt. Holyoke College students. The objects for recognition were presented in identical cardboard boxes and were to be distinguished by the sound and the "feel" as the boxes were handled. The experiment was originally planned for blindfolded college students and calls for learning through the use of auditory and muscular cues.

The seeing subjects again made better records. There were individuals in each group who had great difficulty with the test, but a number of the blind subjects gave it up entirely because it was too hard for them.

When asked what methods were used to distinguish the objects the blind and the seeing gave similar replies. Some depended upon the quality of the sound while others mentioned the force of the objects as they hit the sides of the box.

These two experiments failed to furnish any evidence for a sensory compensation on the part of the blind, although, as Professor Hayes says, many blind people do take advantage of sensory cues which are neglected as unimportant by the seeing.

AERIAL MAPPING AND UNEMPLOYED ENGINEERS

PUTTING a large number of unemployed engineers and assistants quickly to work on an aerial mapping project that promises to be highly valuable to many governmental agencies is the goal of a new Civil Works Administration program.

Airplanes will soon be flying over selected agricultural agencies in ten southern states, while cameras take overhead views of farms and fields. On the ground below, groups of workers will chain off individual properties and plot to scale the results shown on the air pic-

tures. Fitted together, the air photographs will then form a great mosaic picture map of the land.

During 70 days an allotment of $650,000 is to be expended for this purpose. Mapping of 40,000 square miles will proceed as far as possible, with 500 engineers and some 1,500 assistants taking part. The states engaging in the project are Alabama, Arizona, Arkansas, California, Georgia, Louisiana, Mississippi, New Mexico, South Carolina, Texas and the District of Columbia.

The U. S. Geological Survey has charge of the project. Advising and conferring with the survey are representatives from governmental agencies which expect to find the maps useful. These include the Bureau of Census, Agricultural Adjustment Administration, Coast and Geodetic Survey, corps of engineers of the U. S. Army and the Army Air Corps.

It is believed that many additional uses for the maps will occur, once they become permanent government records. They will be employed, perhaps as the first demonstration of their usefulness, in connection with the census of agriculture proposed for next November. Consulting the mosaic strips, enumerators can find obscure farms and buildings that might be otherwise overlooked. Facts about vacant farms, one of the hard problems of the census, can be recorded. Waste land not under cultivation because of gullies, stumps and rocks can be more completely accounted for. This information becomes of great importance in the study of soil erosion. The study of crops can be more effectively determined with the aid of the air maps.

The maps are expected to provide a more accurate record of the land area within townships and counties. The curvature of the earth causes a slight discrepancy in surveying records in a county, unless this has been taken into account. In one county where this discrepancy has not been allowed for, there is a record of more land in farms than the official area of the whole county.

The maps also may become property and real estate evidence. In one county where the aerial mapping system was tried, the untaxed land discovered within the county amounted to a tax fund sufficient to pay for the initial photographic mapping work.

The project of proceeding with mapping of 40,000 square miles may later be extended to an area of a million square miles if additional funds are made available.

ITEMS

COTTON was used as a reinforcing material in making asphalt paving blocks exhibited at a lecture before a Washington audience of the Negro chemist, Professor George W. Carver, who has worked for many years to discover new uses for the agricultural products of the South. About 3½ per cent. of the blocks, by weight, consisted of cotton; the reinforcement increases their strength and resistance to wear. Roads made of these blocks would use up forty bales of cotton to the mile.

CANNIBALISM was a practise among the natives of Britain about the time the Romans came, is the discovery reported by G. C. Dunning, of the Society of Antiquaries. Mr. Dunning found the evidence of human bones split for their marrow while he was excavating at Salmonsbury Camp near Bourton-on-the-Water, in Gloucestershire. About thirty of the split human bones, believed to be female bones, were unearthed. Aside from their cannibalism, the Britons who lived at the site were considerably civilized, Mr. Dunning reported. The surprising feature is that the cannibalistic practises occurred within the Christian era, near the time when the Romans extended their conquest over the island. A pike's head found near the junction of two well-known trout streams was also described. It shows that ancient fishermen used the stream long before its modern era of popularity.

RESISTANCE to disease or susceptibility to it may be inherited. Proof of this appears in a study, made public recently, by Dr. Charles B. Davenport, director of the department of genetics of the Carnegie Institution of Washington, Cold Spring Harbor, New York. Inefficient thyroid glands, for instance, tend to run in families, Dr. Davenport found in a study of goiter in a mountain valley of Western Maryland. While all the population there ate essentially the same food and drank essentially the same water, which was poor in iodine, the majority of the population did not have goiters, although lack of iodine is a factor causing goiter. However, many of the people do have goiters and studies of their relationship showed that the goiters appeared only in certain families. In these all the brothers, sisters and parents might have the condition.

A PHENOMENAL increase in ptarmigan in Mount McKinley National Park, Alaska, in the past four years is reported by Superintendent Harry J. Liek. When Superintendent Liek first went to the park, in the winter of 1929, these interesting birds were rarely even sighted. For two years little increase was noted. Then, in the winter of 1931, small coveys were seen traveling through the park. Now they are everywhere by the thousands, and Mr. Liek reports that flocks of several hundred at headquarters are a common sight. During the winter the ptarmigan in McKinley Park live entirely upon the buds of willows and birch trees.

How did the terns of Bird Key find their way home from the strange skies off Cape Hatteras? Carnegie Institution investigators, after considering all current theories of homing instinct in birds, are still at a loss for a conclusive answer to one of their own experiments. Five terns were taken from the bird rookery off the tip of the Florida peninsula and carried by a roundabout steamer route to a position off Cape Hatteras, where they were given their freedom. Five days from the date of capture, three of them were back on the nesting grounds, where they were identified by the metal bands with which their legs had been encircled before they were taken on their long voyage. The straight-line distance from Cape Hatteras to Bird Key is about 850 miles; by coast-line flight the distance is 1,081 miles. This latter is greater than the record flight for trained pigeons, 1,010 miles.

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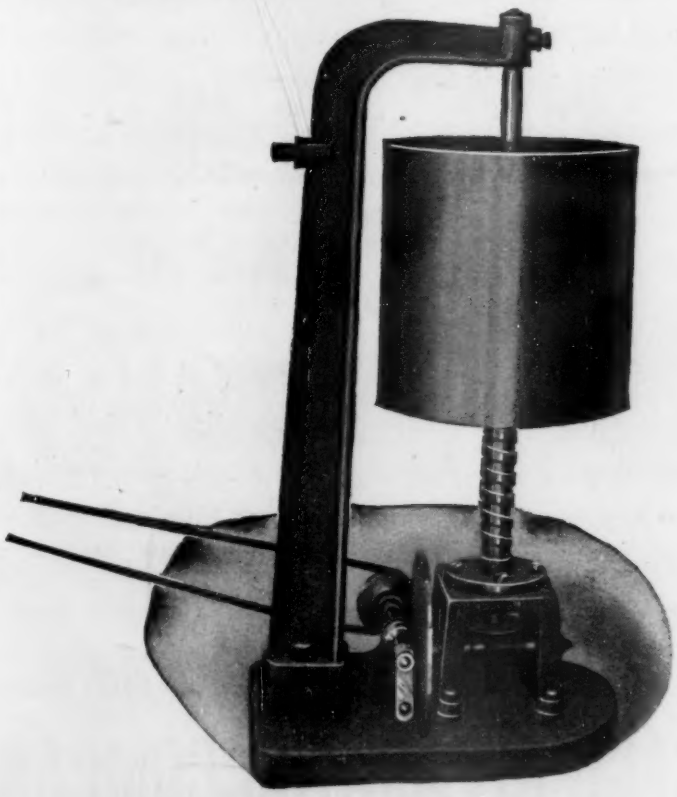

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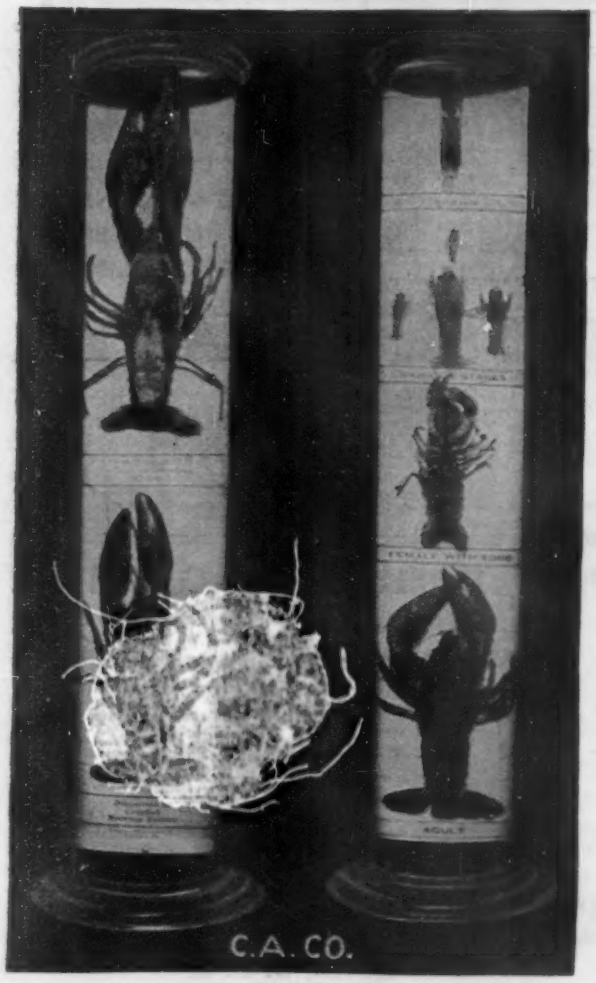

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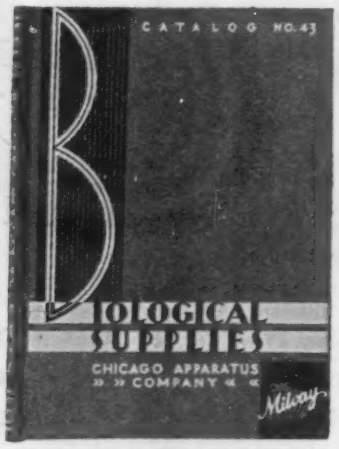

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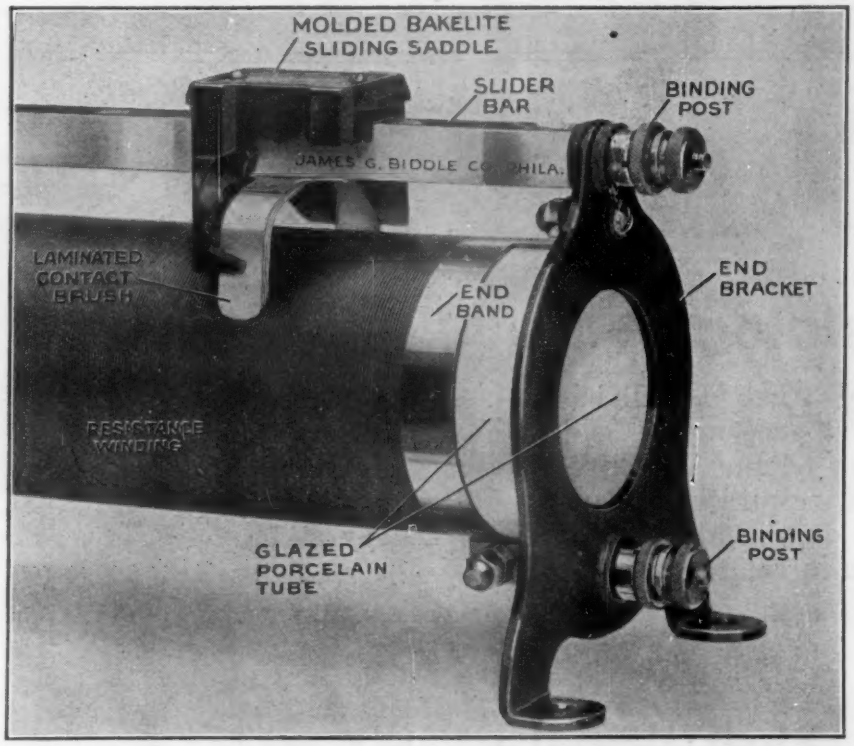

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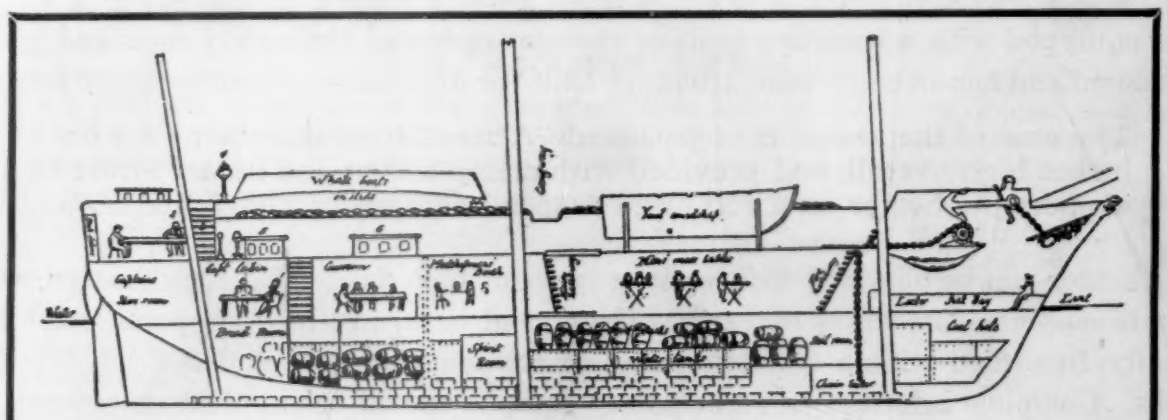

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